

Air



Perchloroethylene Dry Cleaners - Background Information for Proposed Standards

Draft
EIS

DRY CLEANING
AP 42 Section 4.1
Reference Number
2

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

NSRS

EPA-450/3-79-029a

Perchloroethylene Dry Cleaners - Background Information for Proposed Standards

Emission Standards and Engineering Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air, Noise, and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

August 1980

This report has been reviewed by the Emission Standards and Engineering Division of the Office of Air Quality Planning and Standards, EPA, and approved for publication. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use. Copies of this report are available through the Library Services Office (MD-35), U.S. Environmental Protection Agency, Research Triangle Park, N.C. 27711, or from National Technical Information Services, 5285 Port Royal Road, Springfield, Virginia 22161.

Publication No. EPA-450/3-79-029a

Background Information
and Draft
Environmental Impact Statement
for Perchloroethylene Dry Cleaners

Type of Action: Administrative

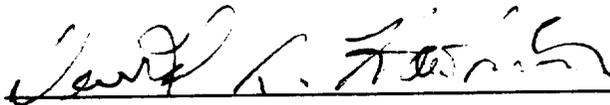
Prepared by:



Don R. Goodwin
Director, Emission Standards and Engineering Division
Environmental Protection Agency
Research Triangle Park, N. C. 27711

6/2/80
(Date)

Approved by:



David G. Hawkins
Assistant Administrator for Air, Noise and Radiation
Environmental Protection Agency
Washington, D. C. 20460

7/2/80
(Date)

Draft Statement Submitted to EPA's
Office of Federal Activities for Review on

7/80
(Date)

This document may be reviewed at:

Central Docket Section
Environmental Protection Agency
West Tower Lobby
Gallery 1, Waterside Mall
401 M St., S. W.
Washington, D. C. 20460

Additional copies may be obtained at:

Environmental Protection Agency Library (MD-35)
Research Triangle Park, N. C. 27711

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

TABLE OF CONTENTS

	<u>Page</u>
LIST OF FIGURES	vii
LIST OF TABLES.	viii
CHAPTER 1. SUMMARY	1-1
1.1 Regulatory Alternatives	1-1
1.2 Environmental Impact	1-2
1.3 Economic Impact.	1-2
CHAPTER 2. INTRODUCTION.	2-1
2.1 Background and Authority for Standards	2-1
2.2 Selection of Categories of Stationary Sources.	2-5
2.3 Procedure for Development of Standards of Performance.	2-6
2.4 Consideration of Costs	2-8
2.5 Consideration of Environmental Impacts	2-9
2.6 Impact on Existing Sources	2-10
2.7 Revision of Standards of Performance	2-11
CHAPTER 3. THE PERCHLOROETHYLENE DRY CLEANING INDUSTRY	3-1
3.1 General Industry Description	3-1
3.2 Dry Cleaning Processes	3-2
3.3 Baseline Emissions	3-7
References for Chapter 3	3-14
CHAPTER 4. EMISSION CONTROL TECHNIQUES	4-1
4.1 Use of Control Techniques.	4-1
4.2 Types of Control Techniques.	4-1
References for Chapter 4	4-12
CHAPTER 5. MODIFICATION AND RECONSTRUCTION	5-1
5.1 40 CFR Part 60 Provisions for Modification and Reconstruction	5-2
5.2 Applicability to Perchloroethylene Dry Cleaning Facilities.	5-3

TABLE OF CONTENTS (continued)

	<u>Page</u>
CHAPTER 6. MODEL PLANTS AND REGULATORY ALTERNATIVES.	6-1
6.1 Model Plants	6-1
6.2 Regulatory Alternatives.	6-3
6.3 Rationale for Ranking of Regulatory Alternatives	6-7
References for Chapter 6	6-10
CHAPTER 7. ENVIRONMENTAL IMPACT.	7-1
7.1 Air Pollution Impact	7-1
7.2 Water Pollution Impacts.	7-6
7.3 Solid Waste Impact	7-10
7.4 Energy Impact.	7-11
References for Chapter 7	7-13
CHAPTER 8. ECONOMIC IMPACT	8-1
8.1 Industry Characterization.	8-1
8.2 Cost Analysis of Control Options	8-23
8.3 Other Cost Considerations.	8-42
8.4 Economic Impact.	8-44
8.5 Socioeconomic Effects.	8-58
References for Chapter 8	8-62
APPENDIX A EVOLUTION OF PROPOSED STANDARDS	A-1
APPENDIX B INDEX TO ENVIRONMENTAL IMPACT CONSIDERATIONS	B-1
APPENDIX C EMISSION SOURCE TEST DATA	C-1
APPENDIX D EMISSION MEASUREMENT AND CONTINUOUS MONITORING.	D-1

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1-1	Assessment of Environmental and Economic Impacts for Each Regulatory Alternative Considered.	1-3
3-1	Perchloroethylene Emissions from Professional Dry Cleaning Plants.	3-8
3-2	Baseline Perchloroethylene Emission Levels	3-10
4-1	Summary of Perchloroethylene Dry Cleaning Test Data . . .	4-4
4-2	Summary of Carbon Adsorber Test Data	4-5
4-3	Filter and Distillation Wastes from Well-Operated Facilities	4-11
6-1	Model Plant Parameters for the Perc Dry Cleaning Industry	6-2
6-2	Control Options.	6-4
6-3	Perchloroethylene Emission Rate after Applying the Air Pollution Control Options to Model Plants.	6-8
7-1	Projected Emission Reduction from Applying the Control Options to Coin-Ops.	7-3
7-2	Projected Emission Reduction from Applying the Control Options to Commercial Dry Cleaning Plants.	7-4
7-3	Projected Emission Reduction from Applying the Control Options to Industrial Dry Cleaning Plants.	7-5
7-4	Increases in F-113 Emissions for Option 1 from the Coin-Op Segment.	7-7
7-5	Increases in F-113 Emissions for Option 1 from the Commercial Segment	7-8
7-6	Perchloroethylene Dry Cleaning Solvent in Effluent Water as a Result of Carbon Adsorption	7-9
7-7	Energy Impact of Control Options on Model Plants	7-12
8-1	Statistical Profile of Coin-Op Dry Cleaners and Laundries (SIC 7215), 1972	8-3
8-2	Statistical Profile of Dry Cleaning Plants, Except Rug Cleaning (SIC 7216), 1972.	8-5
8-3	Statistical Profile of Industrial Launderers (SIC 7218), 1972	8-7
8-4	Trends in Number of Establishments and Employees in the Dry Cleaning Industry.	8-9

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
3-1	Perchloroethylene Dry Cleaning Plant Flow Diagram	3-4
5-1	Plant Configurations Encountered in the Dry Cleaning Industry	5-4
8-1	Trends in Number of Establishments and Employees for SIC 7215.	8-10
8-2	Trends in Number of Establishments and Employees for SIC 7216.	8-12
8-3	Trends in Number of Establishments and Employees for SIC 7218.	8-14

LIST OF TABLES (continued)

<u>TABLE</u>		<u>PAGE</u>
8-5	Consumer Price Index	8-13
8-6	Coin-Operated Dry Cleaners and Laundries, SIC 7215, Regional Trends for Number of Establishments	8-16
8-7	Dry Cleaning Plants Except Rug Cleaning SIC 7216, Regional Trends for Number of Establishments.	8-17
8-8	Industrial Launderers, SIC 7218, Regional Trends for Number of Establishments	8-18
8-9	Ratio of Market Value of Perchloroethylene Production to Total Sales in 1977 for Perc-Producing Companies. . .	8-19
8-10	Estimated New Sources in the Unregulated Perchloroethylene Coin-Op Dry Cleaning Industry.	8-20
8-11	Estimated New Sources in the Unregulated Commercial Perchloroethylene Dry Cleaning Industry.	8-21
8-12	Estimated New Sources in the Unregulated Perchloroethylene Industrial Dry Cleaning Industry	8-22
8-13	Cost of Control Technology, Coin Operated, Option 1 . . .	8-25
8-14	Cost of Control Technology, Evaluation of Applying Carbon Adsorption to Coin-Ops	8-27
8-15	Approximate Capital Costs of Dry Cleaning Machines	8-30
8-16	Cost of Control, Commercial Dry Cleaners, Option 1 and Option 2	8-31
8-17	Cost of Control Technology, Industrial	8-33
8-18	Control Costs for Modifying Commercial Perc Dry Cleaners	8-35
8-19	Control Costs for Modifying Industrial Perc Dry Cleaners	8-36
8-20	Cost (Profit) Effectiveness of Controls for the Perchloroethylene Dry Cleaning Industry.	8-39
8-21	Aggregate Costs of Controls on Dry Cleaning Industry . . .	8-40
8-22	Model Plant Financial Profile	8-48
8-23	Summary of Control Costs	8-51
8-24	Effects of Control Options on Profit and Return on Investment for Model Plants.	8-53
8-25	Effects of Control Options on Number of New Plants	8-57
8-26	Maximum Price Increases Resulting from Alternative Control Options on Dry Cleaning Model Plants	8-60

1. SUMMARY

Standards of performance for new stationary sources are established under section 111 of the Clean Air Act (42 U.S.C. 7411), as amended in 1977. Section 111 directs the Administrator to establish standards of performance for any category of new stationary source of air pollution which ". . . causes or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."

This Background Information Document (BID) supports proposed standards for tetrachloroethylene, more commonly known as perchloroethylene (perc) dry cleaners. Perc dry cleaners can generally be divided into three categories: coin-operated, commercial, and industrial. Coin-operated dry cleaners are usually part of a coin-operated laundry. The equipment is operated by the customer, with the cost of the cleaning usually being deposited directly into the dry cleaning machine. Commercial dry cleaners are the local stores processing men's suits, women's dresses and similar apparel. Industrial dry cleaners usually clean such articles as uniforms, work gloves, or dust mops. Some commercial facilities may process uniforms or other industrial type work, hence, there may not be an absolute distinction between commercial and industrial facilities. These three categories were used to develop the regulatory alternatives and the cost of control for each industry category.

1.1 REGULATORY ALTERNATIVES

There are two regulatory alternatives, each of which vary according to industry category. Alternative I for the coin-operated and commercial categories calls for the use of a solvent such as trichlorotrifluoroethane (F-113*), which will not contribute significantly to oxidant formation. In the industrial category, alternative I calls for the use of carbon

* Registered trademark.

adsorption to control perc emissions from dryers, the elimination of perceptible solvent leaks by proper maintenance, and the treatment of waste solvent to lower the perc content in the waste. Alternative II for the coin-operated category requires that the facility be well maintained, well operated, and all perceptible solvent leaks be repaired with waste solvent minimized by proper treatment. For the commercial and industrial categories, alternative II is the same as for the coin-operated category with the addition of carbon adsorption to control emissions from dryers or dry-to-dry machines.

1.2 ENVIRONMENTAL IMPACT

Regulatory alternative I would reduce nationwide emissions of perc from 55,000 Mg/yr to 47,000 Mg/yr (8,000 Mg/yr) by 1984. This decrease in perc emissions would be accompanied by an increase of 3,100 megagrams in total F-113 emissions. As shown in Table 1-1 the environmental impacts of alternative I on water pollution, solid waste, and energy would be minimal.

Regulatory alternative II would reduce nationwide perc emissions from 55,000 Mg/yr to 51,000 Mg/yr (4,000 Mg/yr) by 1984. The reduction in nationwide perc emissions would result in minimal adverse environmental impacts. There would be negligible increases in solid waste and perc in wastewater. Compliance with the proposed standard would also cause a slight increase in energy consumption due to the use of carbon adsorbers.

1.3 ECONOMIC IMPACT

Regulatory alternative I would result in an increase of approximately 23 million dollars in industrywide capital investment costs by 1984. In 1984, the total annualized costs resulting from alternative I would be approximately 7.2 million dollars. The industrial sector, however, may actually experience a beneficial economic impact under alternative I due to the recovery of solvents.

For regulatory alternative II, total capital investment costs of controls by 1984 would be about 7.2 million dollars. The 1984 total annualized costs resulting from controls would be less than 0.8 million dollars.

Table 1-1. ASSESSMENT OF ENVIRONMENTAL AND ECONOMIC IMPACTS FOR EACH REGULATORY ALTERNATIVE CONSIDERED^a

Administrative action	Air impact	Water impact	Solid waste impact	Energy impact	Noise impact	Economic impact	Inflationary impact
Regulatory alternative I	+2**†	-1**	-1**	-1**	0	-3**	-1**
Regulatory alternative II	+2**	-1**	-1**	-1**	0	-1**	-1**
No Standards or Delayed Standards	+1**	0	-1**	0	0	+1**	0

^a Key:

+ Beneficial Impact
- Adverse Impact

0 No Impact
1 Negligible Impact
2 Small Impact
3 Moderate Impact
4 Large Impact

* Short-term Impact
** Long-term Impact
*** Irreversible Impact

† +3 attributed to volatile organic compound reduction, and
-1 attributed to increase in F-113 emissions yields a net air impact of +2.

There is not expected to be any consumer price increase incurred by any regulatory action on new sources. This is due to the competitiveness of the market, and to the fact that a new source locating in an area could not charge higher prices and still attract customers. Regulatory action which would result in a need for significantly increased costs to the consumer to make the facility profitable would result in the pre-emption of construction of the facility.

2. INTRODUCTION

2.1 BACKGROUND AND AUTHORITY FOR STANDARDS

Before standards of performance are proposed as a Federal regulation, air pollution control methods available to the affected industry and the associated costs of installing and maintaining the control equipment are examined in detail. Various levels of control based on different technologies and degrees of efficiency are expressed as regulatory alternatives. Each of these alternatives is studied by EPA as a prospective basis for a standard. The alternatives are investigated in terms of their impacts on the economics and well-being of the industry, the impacts on the national economy, and the impacts on the environment. This document summarizes the information obtained through these studies so that interested persons will be able to see to the information considered by EPA in the development of the proposed standard.

Standards of performance for new stationary sources are established under section 111 of the Clean Air Act (42 U.S.C. 7411) as amended, hereinafter referred to as the Act. Section 111 directs the Administrator to establish standards of performance for any category of new stationary source of air pollution which ". . . causes, or contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare."

The Act requires that standards of performance for stationary sources reflect, ". . . the degree of emission reduction achievable which (taking into consideration the cost of achieving such emission reduction, and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated for that category of sources." The standards apply only to stationary sources, the construction or modification of which commences after regulations are proposed by publication in the Federal Register.

The 1977 amendments to the Act altered or added numerous provisions that apply to the process of establishing standards of performance.

1. EPA is required to list the categories of major stationary sources that have not already been listed and regulated under standards of performance. Regulations must be promulgated for these new categories on the following schedule:

- a. 25 percent of the listed categories by August 7, 1980.
- b. 75 percent of the listed categories by August 7, 1981.
- c. 100 percent of the listed categories by August 7, 1982.

A governor of a State may apply to the Administrator to add a category not on the list or may apply to the Administrator to have a standard of performance revised.

2. EPA is required to review the standards of performance every 4 years and, if appropriate, revise them.

3. EPA is authorized to promulgate a standard based on design, equipment, work practice, or operational procedures when a standard based on emission levels is not feasible.

4. The term "standards of performance" is redefined, and a new term "technological system of continuous emission reduction" is defined. The new definitions clarify that the control system must be continuous and may include a low- or non-polluting process or operation.

5. The time between the proposal and promulgation of a standard under Section 111 of the Act may be extended to 6 months.

Standards of performance, by themselves, do not guarantee protection of health or welfare because they are not designed to achieve any specific air quality levels. Rather, they are designed to reflect the degree of emission limitation achievable through application of the best adequately demonstrated technological system of continuous emission reduction, taking into consideration the cost of achieving such emission reduction, any non-air-quality health and environmental impacts, and energy requirements.

Congress had several reasons for including these requirements. First, standards with a degree of uniformity are needed to avoid situations where some States may attract industries by relaxing standards relative to other States. Second, stringent standards enhance the potential for long-term

growth. Third, stringent standards may help achieve long-term cost savings by avoiding the need for more expensive retrofiting when pollution ceilings may be reduced in the future. Fourth, certain types of standards for coal-burning sources can adversely affect the coal market by driving up the price of low-sulfur coal or effectively excluding certain coals from the reserve base because their untreated pollution potentials are high. Congress does not intend that new source performance standards contribute to these problems. Fifth, the standard-setting process should create incentives for improved technology.

Promulgation of standards of performance does not prevent State or local agencies from adopting more stringent emission limitations for the same sources. States are free under section 116 of the Act to establish even more stringent emission limits than those established under section 111 or those necessary to attain or maintain the National Ambient Air Quality Standards (NAAQS) under section 110. Thus, new sources may in some cases be subject to limitations more stringent than standards of performance under section 111, and prospective owners and operators of new sources should be aware of this possibility in planning for such facilities.

A similar situation may arise when a major emitting facility is to be constructed in a geographic area that falls under the prevention of significant deterioration of air quality provisions of Part C of the Act. These provisions require, among other things, that major emitting facilities to be constructed in such areas are to be subject to best available control technology. The term Best Available Control Technology (BACT), as defined in the Act, means

. . . an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this Act emitted from, or which results from, any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of each such pollutant.

In no event shall application of 'best available control technology' result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard established pursuant to sections 111 or 112 of this Act. (Section 169(3))

Although standards of performance are normally structured in terms of numerical emission limits where feasible, alternative approaches are sometimes necessary. In some cases physical measurement of emissions from a new source may be impractical or exorbitantly expensive. Section 111(h) provides that the Administrator may promulgate a design or equipment standard in those cases where it is not feasible to prescribe or enforce a standard of performance. For example, emissions of hydrocarbons from storage vessels for petroleum liquids are greatest during tank filling. The nature of the emissions, high concentrations for short periods during filling and low concentrations for longer periods during storage, and the configuration of storage tanks make direct emission measurement impractical. Therefore, a more practical approach to standards of performance for storage vessels has been equipment specification.

In addition, section 111(i) authorizes the Administrator to grant waivers of compliance to permit a source to use innovative continuous emission control technology. In order to grant the waiver, the Administrator must find: (1) a substantial likelihood that the technology will produce greater emission reductions than the standards require or an equivalent reduction at lower economic energy or environmental cost; (2) the proposed system has not been adequately demonstrated; (3) the technology will not cause or contribute to an unreasonable risk to the public health, welfare, or safety; (4) the governor of the State where the source is located consents; and (5) the waiver will not prevent the attainment or maintenance of any ambient standard. A waiver may have conditions attached to assure the source will not prevent attainment of any NAAQS. Any such condition will have the force of a performance standard. Finally, waivers have definite end dates and may be terminated earlier if the conditions are not met or if the system fails to perform as expected. In such a case, the source may be given up to 3 years to meet the standards with a mandatory progress schedule.

2.2 SELECTION OF CATEGORIES OF STATIONARY SOURCES

Section 111 of the Act directs the Administrator to list categories of stationary sources. The Administrator ". . . shall include a category of sources in such list if in his judgement it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare." Proposal and promulgation of standards of performance are to follow.

Since passage of the Clean Air Amendments of 1970, considerable attention has been given to the development of a system for assigning priorities to various source categories. The approach specifies areas of interest by considering the broad strategy of the Agency for implementing the Clean Air Act. Often, these "areas" are actually pollutants emitted by stationary sources. Source categories that emit these pollutants are evaluated and ranked by a process involving such factors as: (1) the level of emission control (if any) already required by State regulations, (2) estimated levels of control that might be required from standards of performance for the source category, (3) projections of growth and replacement of existing facilities for the source category, and (4) the estimated incremental amount of air pollution that could be prevented in a preselected future year by standards of performance for the source category. Sources for which new source performance standards were promulgated or under development during 1977, or earlier, were selected on these criteria.

The Act amendments of August 1977 establish specific criteria to be used in determining priorities for all major source categories not yet listed by EPA. These are: (1) the quantity of air pollutant emissions that each such category will emit, or will be designed to emit; (2) the extent to which each such pollutant may reasonably be anticipated to endanger public health or welfare; and (3) the mobility and competitive nature of each such category of sources and the consequent need for nationally applicable new source standards of performance.

The Administrator is to promulgate standards for these categories according to the schedule referred to earlier.

In some cases it may not be feasible immediately to develop a standard for a source category with a high priority. This might happen when a

program of research is needed to develop control techniques or because techniques for sampling and measuring emissions may require refinement. In the developing of standards, differences in the time required to complete the necessary investigation for different source categories must also be considered. For example, substantially more time may be necessary if numerous pollutants must be investigated from a single source category. Further, even late in the development process the schedule for completion of a standard may change. For example, inability to obtain emission data from well-controlled sources in time to pursue the development process in a systematic fashion may force a change in scheduling. Nevertheless, priority ranking is, and will continue to be, used to establish the order in which projects are initiated and resources assigned.

After the source category has been chosen, the types of facilities within the source category to which the standard will apply must be determined. A source category may have several facilities that cause air pollution, and emissions from some of these facilities may vary from insignificant to very expensive to control. Economic studies of the source category and of applicable control technology may show that air pollution control is better served by applying standards to the more severe pollution sources. For this reason, and because there is no adequately demonstrated system for controlling emissions from certain facilities, standards often do not apply to all facilities at a source. For the same reasons, the standards may not apply to all air pollutants emitted. Thus, although a source category may be selected to be covered by a standard of performance, not all pollutants or facilities within that source category may be covered by the standards.

2.3 PROCEDURE FOR DEVELOPMENT OF STANDARDS OF PERFORMANCE

Standards of performance must (1) realistically reflect best demonstrated control practice; (2) adequately consider the cost, the non-air-quality health and environmental impacts, and the energy requirements of such control; (3) be applicable to existing sources that are modified or reconstructed as well as new installations; and (4) meet these conditions for all variations of operating conditions being considered anywhere in the country.

The objective of a program for developing standards is to identify the best technological system of continuous emission reduction that has been adequately demonstrated. The standard-setting process involves three principal phases of activity: (1) information gathering, (2) analysis of the information, and (3) development of the standard of performance.

During the information-gathering phase, industries are queried through a telephone survey, letters of inquiry, and plant visits by EPA representatives. Information is also gathered from many other sources, and a literature search is conducted. From the knowledge acquired about the industry, EPA selects certain plants at which emission tests are conducted to provide reliable data that characterize the pollutant emissions from well-controlled existing facilities.

In the second phase of a project, the information about the industry and the pollutants emitted is used in analytical studies. Hypothetical "model plants" are defined to provide a common basis for analysis. The model plant definitions, national pollutant emission data, and existing State regulations governing emissions from the source category are then used in establishing "regulatory alternatives." These regulatory alternatives are essentially different levels of emission control.

EPA conducts studies to determine the impact of each regulatory alternative on the economics of the industry and on the national economy, on the environment, and on energy consumption. From several possibly applicable alternatives, EPA selects the single most plausible regulatory alternative as the basis for a standard of performance for the source category under study.

In the third phase of a project, the selected regulatory alternative is translated into a standard of performance, which, in turn, is written in the form of a Federal regulation. The Federal regulation, when applied to newly constructed plants, will limit emissions to the levels indicated in the selected regulatory alternative.

As early as is practical in each standard-setting project, EPA representatives discuss the possibilities of a standard and the form it might take with members of the National Air Pollution Control Techniques Advisory Committee. Industry representatives and other interested parties also participate in these meetings.

The information acquired in the project is summarized in the Background Information Document (BID). The BID, the standard, and a preamble explaining the standard are widely circulated to the industry being considered for control, environmental groups, other government agencies, and offices within EPA. Through this extensive review process, the points of view of expert reviewers are taken into consideration as changes are made to the documentation.

A "proposal package" is assembled and sent through the offices of EPA Assistant Administrators for concurrence before the proposed standard is officially endorsed by the EPA Administrator. After being approved by the EPA Administrator, the preamble and the proposed regulation are published in the Federal Register.

As a part of the Federal Register announcement of the proposed regulation, the public is invited to participate in the standard-setting process. EPA invites written comments on the proposal and also holds a public hearing to discuss the proposed standard with interested parties. All public comments are summarized and incorporated into a second volume of the BID. All information reviewed and generated in studies in support of the standard of performance is available to the public in a "docket" on file in Washington, D. C.

Comments from the public are evaluated, and the standard of performance may be altered in response to the comments.

The significant comments and EPA's position on the issues raised are included in the "preamble" of a promulgation package," which also contains the draft of the final regulation. The regulation is then subjected to another round of review and refinement until it is approved by the EPA Administrator. After the Administrator signs the regulation, it is published as a "final rule" in the Federal Register.

2.4 CONSIDERATION OF COSTS

Section 317 of the Act requires an economic impact assessment with respect to any standard of performance established under Section 111 of the Act. The assessment is required to contain an analysis of: (1) the costs of compliance with the regulation, including the extent to which the cost of compliance varies depending on the effective date of the regulation and the development of less expensive or more efficient methods of compliance;

(2) the potential inflationary or recessionary effects of the regulation; (3) the effects the regulation might have on small business with respect to competition; (4) the effects of the regulation on consumer costs; and (5) the effects of the regulation on energy use. Section 317 also requires that the economic impact assessment be as extensive as practicable.

The economic impact of a proposed standard upon an industry is usually addressed both in absolute terms and in terms of the control costs that would be incurred as a result of compliance with typical, existing State control regulations. An incremental approach is necessary because both new and existing plants would be required to comply with State regulations in the absence of a Federal standard of performance. This approach requires a detailed analysis of the economic impact from the cost differential that would exist between a proposed standard of performance and the typical State standard.

Air pollutant emissions may cause water pollution problems, and captured potential air pollutants may pose a solid waste disposal problem. The total environmental impact of an emission source must, therefore, be analyzed and the costs determined whenever possible.

A thorough study of the profitability and price-setting mechanisms of the industry is essential to the analysis so that an accurate estimate of potential adverse economic impacts can be made for proposed standards. It is also essential to know the capital requirements for pollution control systems already placed on plants so that the additional capital requirements necessitated by these Federal standards can be placed in proper perspective. Finally, it is necessary to assess the availability of capital to provide the additional control equipment needed to meet the standards of performance.

2.5 CONSIDERATION OF ENVIRONMENTAL IMPACTS

Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969 requires Federal agencies to prepare detailed environmental impact statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The objective of NEPA is to build into the decisionmaking process of Federal agencies a careful consideration of all environmental aspects of proposed actions.

In a number of legal challenges to standards of performance for various industries, the United States Court of Appeals for the District of Columbia Circuit has held that environmental impact statements need not be prepared by the Agency for proposed actions under section 111 of the Clean Air Act. Essentially, the Court of Appeals has determined that the best system of emission reduction requires the Administrator to take into account counter-productive environmental effects of a proposed standard, as well as economic costs to the industry. On this basis, therefore, the Court established a narrow exemption from NEPA for EPA determination under section 111.

In addition to these judicial determinations, the Energy Supply and Environmental Coordination Act (ESECA) of 1974 (PL-93-319) specifically exempted proposed actions under the Clean Air Act from NEPA requirements. According to section 7(c)(1), "No action taken under the Clean Air Act shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969." (15 U.S.C. 793(c)(1))

Nevertheless, the Agency has concluded that the preparation of environmental impact statements could have beneficial effects on certain regulatory actions. Consequently, although not legally required to do so by section 102(2)(C) of NEPA, EPA has adopted a policy requiring that environmental impact statements be prepared for various regulatory actions, including standards of performance developed under section 111 of the Act. This voluntary preparation of environmental impact statements, however, in no way legally subjects the Agency to NEPA requirements.

To implement this policy, a separate section in this document is devoted solely to an analysis of the potential environmental impacts associated with the proposed standards. Both adverse and beneficial impacts in such areas as air and water pollution, increased solid waste disposal, and increased energy consumption are discussed.

2.6 IMPACT ON EXISTING SOURCES

Section 111 of the Act defines a new source as ". . . any stationary source, the construction or modification of which is commenced . . ." after the proposed standards are published. An existing source is redefined as a new source if "modified" or "reconstructed" as defined in amendments to the

general provisions of Subpart A of 40 CFR Part 60, which were promulgated in the Federal Register on December 16, 1975 (40 FR 58416).

Any physical or operational change to an existing facility which results in an increase in the emission rate of any pollutant for which a standard applies is considered a modification. Reconstruction, on the other hand, means the replacement of components of an existing facility to the extent that the fixed capital cost exceeds 50 percent of the cost of constructing a comparable entirely new source and that it be technically and economically feasible to meet the applicable standards. In such cases, reconstruction is equivalent to a new construction.

Promulgation of a standard of performance requires States to establish standards of performance for existing sources in the same industry under Section 111(d) of the Act if the standard for new sources limits emissions of a designated pollutant (i.e., a pollutant for which air quality criteria have not been issued under Section 108 or which has not been listed as a hazardous pollutant under Section 112). If a State does not act, EPA must establish such standards. General provisions outlining procedures for control of existing sources under Section 111(d) were promulgated on November 17, 1975, as Subpart B of 40 CFR Part 60 (40 FR 53340).

2.7 REVISION OF STANDARDS OF PERFORMANCE

Congress was aware that the level of air pollution control achievable by any industry may improve with technological advances. Accordingly, Section 111 of the Act provides that the Administrator ". . . shall, at least every 4 years, review and, if appropriate, revise . . ." the standards. Revisions are made to assure that the standards continue to reflect the best systems that become available in the future. Such revisions will not be retroactive but will apply to stationary sources constructed or modified after the proposal of the revised standards.

3. THE PERCHLOROETHYLENE DRY CLEANING INDUSTRY

This section provides a brief background description of the domestic dry cleaning industry. The dry cleaning process and its emissions are described.

3.1 GENERAL INDUSTRY DESCRIPTION

The dry cleaning industry is a service industry involved in the cleaning and renting of apparel. The industry is basically composed of three categories that are segregated by the type of services they offer. These are (1) coin-operated facilities, (2) commercial dry cleaners, and (3) industrial dry cleaners.

Coin-operated perchloroethylene (perc) dry cleaning facilities are usually, but not necessarily, part of a "laundromat" facility and operate on either an independent or franchise basis. They provide low-cost, self-service dry cleaning without pressing, spotting, or other associated services. Since all coin-operated laundromat facilities do not contain dry cleaning equipment, there is some variation in coin-operated dry cleaning population estimates. Bureau of Census data for 1976 indicated a coin-operated dry cleaning facility population of 11,804 facilities (County Business Patterns, 1976). An industry source estimated the 1979 population of coin-operated laundromat facilities at 40,000 with 15,000 to 18,000 having dry cleaning machines (Gill, W., 18 January 1979). The difference between the two estimates is due primarily to different methods of measurement. Coin-operated dry cleaning facilities usually have two or three dry cleaning machines and an approximate annual throughput of 8,986 kg (19,811 lbs) of clothes (County Business Patterns, 1976). Approximately 97.5 percent of the coin-operated machines use perc.

Commercial perc dry cleaning plants are the most familiar type of facilities, offering the normal services of cleaning soiled apparel or

other fine goods. They include small neighborhood dry cleaning shops operating on an independent basis ("Mom and Pop" dry cleaners), the franchise dry cleaning shops ("One Hour Martinizing"), and the specialty cleaners which handle leather and other fine goods. Bureau of Census data indicated a 1976 commercial dry cleaner population of 19,953 facilities (County Business Patterns, 1976). An industry source estimated the 1979 commercial dry cleaning population at 25,000 facilities (Fisher, W., 19 January 1979). Again these differences are probably due to different methods of measurement (for further explanation see Section 8.1.2). Commercial installations usually have one dry cleaning system and have an annual throughput of less than 23,000 to 113,000 kg (<50,000-250,000 lbs) of clothes according to IFI data (Watt, A., January-February 1975). Approximately 73 percent of the dry cleaning equipment found in commercial facilities uses perc; of the remaining commercial facilities, 24 percent use petroleum and 3 percent use trichlorotrifluoroethane (F-113) (Fisher, W., 19 January 1979).

The industrial dry cleaners are the largest dry cleaning plants, predominantly supplying rental services of uniforms or other items to business, industrial, or institutional customers. Bureau of Census data indicated a 1976 population of 913 industrial laundry facilities (County Business Patterns, 1976). However, all industrial laundry facilities do not have dry cleaning equipment. An industry spokesman has estimated that 40 to 45 percent have dry cleaning equipment (Dees, E., 7 May 1979). The typical industrial dry cleaning facility has one dry cleaning system with an annual throughput of 240,000 to 700,000 kg (530,000 to 1,500,000 lbs) of clothes (Sluizer, M., 1 March 1979). Approximately 50 percent of the dry cleaning equipment found in the industrial facility sector uses perc (Sluizer, M., 1 March 1979).

3.2 DRY CLEANING PROCESSES

3.2.1 The Basic Process

Dry cleaning is essentially a waterless process in which clothes are cleaned with an organic solvent rather than with soap and water. The principal steps in the process are identical to those of laundering in water. In the first step, clothes are loaded into the washer, and solvent is added. The clothes and solvent are then agitated by the turning

motion of a paddle or wheel. After washing is completed, the clothes are spun as in a conventional washer spin cycle to remove the solvent. This part of the process is called extraction. After extraction, the used solvent is filtered and distilled to remove impurities and is then returned to the system. The filtered solids, or "muck," contain solvent which is removed and returned to the system. After solvent wash and extraction, the clothes are tumbled dry. During the drying cycle, much of the evaporated solvent is recovered in a condenser and returned to the system. Remaining solvent in the clothes is reduced by venting ambient air thru the clothes. This process is called aeration or deodorization.

The solvents used are categorized into two broad groups--(1) petroleum solvents, which are mixtures of paraffins and aromatic hydrocarbons similar to kerosene and (2) synthetic solvents, which are halogenated hydrocarbons, perc, and F-113. Differences between the dry cleaning procedures for these two groups of solvents are due to the following factors:

- Synthetic solvents are more expensive than petroleum solvents.
- Petroleum solvents are combustible while synthetic solvents are nonflammable.
- The densities of synthetic solvents are about twice those of petroleum solvents.
- OSHA standards for perc are more stringent than those for petroleum solvents. OSHA standards for F-113 are considerably less strict than those for perc or petroleum solvents.

Figure 3-1 is a schematic of a synthetic solvent-based plant.

3.2.2 Perchloroethylene Plants

As explained in section 3.1, the perc system population as a percentage of total dry cleaning machines comprises 97.5 percent of coin-operated facilities, 73 percent of commercial facilities, and 50 percent of industrial facilities for totals in each industry sector of 11,804, 15,060, and 239, respectively. In order to classify and quantify perc dry cleaning equipment and emissions, EPA tested a large commercial plant, four average commercial plants, and a large industrial plant (plants A-E as described in appendix C). No emission tests were performed on coin-operated machines.

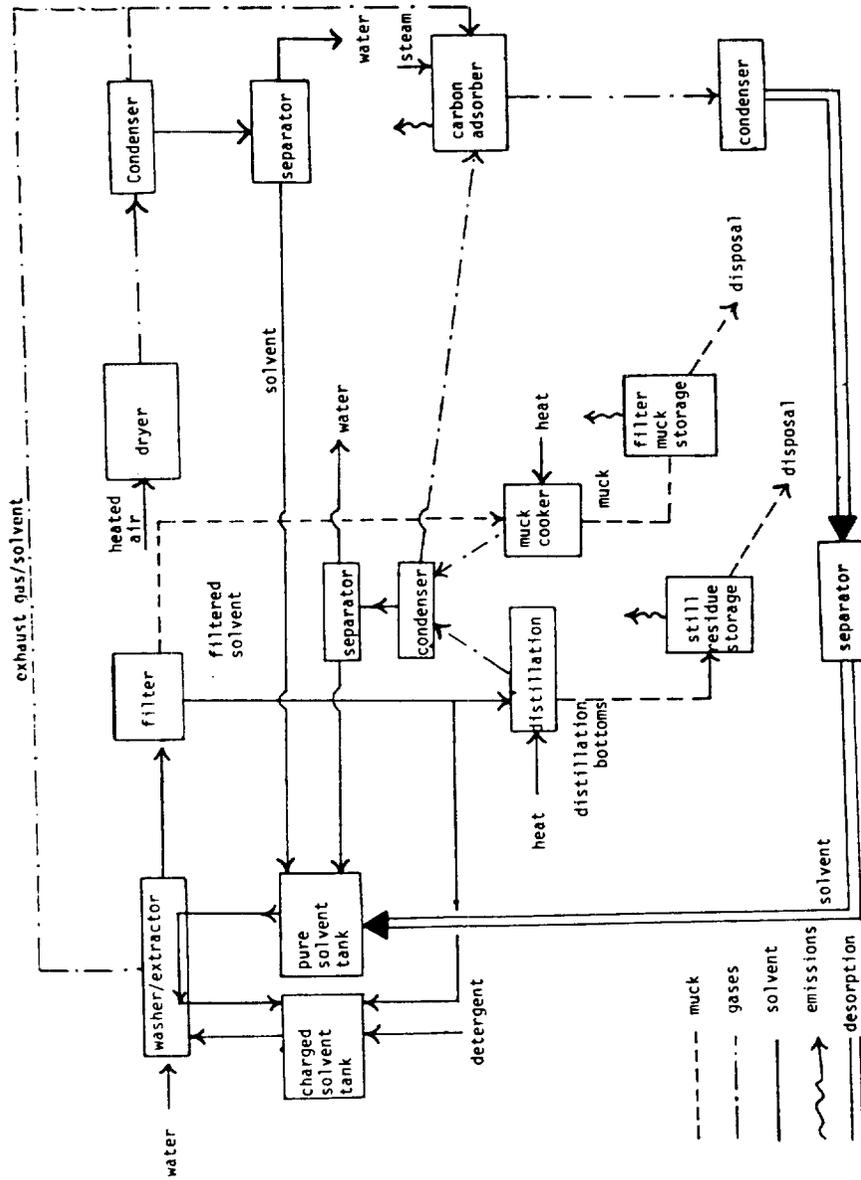


Figure 3-1. Perchloroethylene dry cleaning plant flow diagram.

3.2.2.1 Equipment Characteristics. There are two basic types of dry cleaning machines:

- Transfer machines are those in which washing and drying are performed in different machines. After washing and extraction, the fabrics must be transferred to the dryer.
- Dry-to-dry machines are those in which washing and drying occur in a single unit. In the past, these were termed "hot" machines because they were hot at the end of the complete cycle. In view of technological advancements in the field of room and low temperature drying, this name is no longer applicable.

Perc systems use either type of operation. In the commercial and industrial sectors the majority of perc systems are transfer systems (Victor, Irving, 1 November 1978), whereas all coin-ops are dry-to-dry systems. Dry-to-dry systems have the following disadvantages:

- A dry-to-dry operation can handle about half as many loads per day as a transfer operation. Because washing and drying are performed in different pieces of equipment in transfer operations, these operations can occur simultaneously on different cleaning batches. In a dry-to-dry machine a given load must be washed and dried in the same machine.
- Because the dry-to-dry machine is hot at the end of the drying cycle, the incoming solvent for the next cycle picks up a large amount of heat. This can adversely affect the machine seals and some delicate fabrics as well as increase solvent vapor losses. It should be noted that advancement is being made in the field of low temperature dry-to-dry machines. This advancement would nullify the disadvantage.

In spite of these disadvantages, dry-to-dry machines are of increasing interest to the industry as a result of the following advantages:

- Because there is no transfer of solvent-laden clothing between the washing and drying cycles, there is little chance for perc vapors to escape into the work area. For this reason, dry-to-dry units will comply more easily with Occupational Safety and Health Administration (OSHA) requirements for maximum perc concentrations in the work area than transfer units will.

- The machines are simple to operate and require little attention by the operator during the cleaning cycle.

3.2.2.2 Solvent Characteristics. Though one other halogenated hydrocarbon solvent, F-113 (trichlorotrifluoroethane), is used for dry cleaning in the United States, perc (tetrachloroethylene) is the most common dry cleaning solvent, accounting for 97.5, 73, and 50 percent of the dry cleaning systems in the coin-operated, commercial, and industrial sections, respectively. An estimated 167 million kg of perc (Laundry and Cleaners Allied Trades Association, Inc., December 1978) are used annually for dry cleaning purposes. Characteristics of perc include:

- Nonflammability
- High vapor density
- High cost (\$0.49/kg, (\$3.00/gal.)) (Fisher, W. E., 21 September 1978)
- Aggressive solvent properties

3.2.2.3 Solvent Treatment. Because of the expense of perc, economic operation necessitates at least partial recovery and reuse of used solvent. To accomplish this, some solvent conditioning steps are required to prevent solvent degradation and to otherwise enhance the cleaning operation. These steps include filtration, distillation, and charging.

Filtration -

Some of the soils removed from fabrics are not soluble and must be filtered from the solvent. The filters may contain activated carbon for the removal of dye from the solvent. The solids or "muck" which are removed from the filters contain solvent that is recovered by distillation in perc plants, except in the case of cartridge filters. Cartridge filters are normally just drained in their housing and are then discarded with trash.

Distillation -

In addition to the insoluble residue, which is removed by filtration, a buildup of soluble nonvolatile residue (NVR) occurs in the solvent. NVR is composed primarily of oils, fats, and greases cleaned from fabrics. It is eliminated from the used solvent by distillation. In some perc plants, a single unit serves for distillation of both the used solvent and the filter muck.

Charging -

To remove water-soluble materials from fabric during dry cleaning, a small amount of detergent and water must be added to the solvent in a step known as charging. Because these additives are removed during distillation, they must be replaced prior to solvent reuse.

3.3 BASELINE EMISSIONS

3.3.1 Plant Emissions

Table 3-1 shows solvent losses for both controlled and uncontrolled professional perc dry cleaning systems. These estimates are based on well-operated commercial and industrial plants as reported by IFI (Fisher, W. E., July-August 1975). EPA data are also given in Table 3-1 from the testing of one industrial and four commercial dry cleaning plants. It should be noted that total perc emissions from dry cleaning facilities can vary greatly with operational, maintenance, and housekeeping procedures. The data presented in Table 3-1 are from well-operated and well-controlled facilities and do not represent the norm in the industry. As shown here, uncontrolled systems have high emission rates from filter muck and dryer exhaust. The figures for dryer emissions assume that a reclaiming dryer with a vapor condenser is in use. After wash and extraction, dry-cleaned materials contain approximately 20 to 25 percent solvent by weight. The condenser on the reclaiming dryer reduces these potential perc losses to 3 to 6 percent.

Other sources of vapor losses include evaporation at the washer, distillation unit residue disposal, and miscellaneous sources. The miscellaneous sources include losses from pumps, valves, flanges, and seals; chemical and water separators; and inefficiencies in handling solvent materials.

According to IFI data (Fisher, W. E., July-August 1975), the usual commercial plant has a regenerative filter with a muck cooker. This can result in a total emission rate of about 8.1 kg of solvent per 100 kg of clothing. For an adsorber-equipped system, the emission rate is estimated at approximately 4.9 kg per 100 kg of clothing. This represents a reduction of about 40 percent. It should be noted that these figures are based on industry-generated statistics which do not necessarily agree with EPA's test data.

Table 3-1. PERCHLOROETHYLENE EMISSIONS FROM PROFESSIONAL DRY CLEANING PLANTS^{a-e}

Source	Emissions, kg/100 kg of clothing	
	Plants without vapor adsorber	Plants with vapor adsorber
Evaporation @ washer	0.54 (1)	-
Evaporation @ dryer	3. (6)	-
Vapor adsorber exhaust (Properly operated)	-	0.3 (0.3)
Retention in filter much		
• Rigid tube filter-no cooker	14.	14.
• Rigid tube filter-muck cooker	1.6	1.6
• Regenerative filter-muck cooker	1. (1)	1. (1)
Retention in paper cartridges		
• Drained	1.8 (0.6)	1.8 (0.6)
• Dried in cabinet vented to adsorber	-	1.2
Retention in still residue	1.6 (1) ^f	1.6 (1) ^f
Miscellaneous losses	2. (1)	2. (1)
TOTAL	8-21 (10.6)	6-18 (3.9)

^aFisher, W. E., July-August 1975.

^bKleeberg, Charles F., 17 March 1976.

^cKleeberg, Charles F., 14 May 1976.

^dKleeberg, Charles F., 17 May 1976.

^eIFI data (EPA data).

^fNo EPA test data, 1 assumed.

EPA data show that a commercial or industrial plant that has a regenerative filter with a muck cooker yields a total emission rate of about 10.6 kg per 100 kg of clothing and that an adsorber-equipped system yields an emission rate of 3.9 kg per 100 kg of clothing. This represents a 63 percent reduction in the emission rate (Kleeberg, C. F., 17 March 1976) (Kleeberg, C. F., 14 May 1976) (Kleeberg, C. F., 17 May 1976).

Carbon adsorbers are now being used by about 35 percent of the commercial systems (Matthews, Stanley, 5 November 1978) and 50 percent of the industrial systems (Victor, Irving, 1 November 1978). Carbon adsorbers are not considered feasible for use in coin-op systems because there is usually not enough space for a boiler on the premises to supply the steam necessary to desorb the carbon bed. According to a Dow Survey (Cunniff, Joseph, 3 March 1977), about 5 percent of coin-op machines use carbon adsorbers. In Table 3-2 the baseline emission levels are determined for each of the industry sectors accounting for plants already equipped with controls.

Note that the Dow Survey also gives data on the proportion of dry cleaners meetings given solvent mileages. For the coin-op segment of the industry, the average mileage gives a perc loss of about 16 kilograms per 100 kilograms of clothing. The most efficient 20 percent, however, have a perc loss rate of about 12 kilograms per 100 kilograms. Better control is achieved by proper maintenance and proper waste solvent treatment.

DATA FOR DETERMINING BASELINE EMISSION LEVELS

As noted in section 3.3.1, the emission test data in Table 3-1 represent well-controlled facilities in the industry. In order to determine actual baseline emission levels, however, it is necessary to quantify perc emissions from typical or average plants in the industry. The following discussion explain the derivation of the baseline emission levels for each industry sector. Table 3-2 summarizes the baseline emission levels.

Coin-Op

Assumptions: 5 percent of coin-op machines have carbon adsorbers.

Emission Rate with Carbon Adsorption = 11.3 kg of solvent per 100 kg
of clothes cleaned

Table 3-2. BASELINE PERCHLOROETHYLENE EMISSION LEVELS^{a,b}

Industry sector	Emissions, kg/100 kg of clothing		
	Uncontrolled	Controlled	Sector average ^c
Coin-operated sector	15.9	11.3	15.7
Commercial sector	10.1	8.4	9.5
Industrial sector	11.4	9.5	10.4

^aCuniff, Joseph, 3 March 1977.

^bKleeberg, C. F., 14 May 1976.

^cBased on percentage of controlled plants (coin-operated - 5%; commercial - 35%, and industrial - 50%).

Emission Rate without Carbon Adsorption = 15.9 kg of solvent per 100 kg of clothes cleaned

Baseline Emission Rate = $(0.95)(15.9) + (0.05)(11.3) = 15.7$ kg of solvent per 100 kg of clothes cleaned

Commercial

Assumptions: 35 percent of commercial machines have carbon adsorbers.

Emission Rate with Carbon Adsorption = 8.4 kg of solvent per 100 kg of clothes cleaned

Emission Rate without Carbon Adsorption = 10.1 kg of solvent per 100 kg of clothes cleaned

Baseline Emission Rate = $(0.35)(8.4) + (0.65)(10.1) = 9.5$ kg of solvent per 100 kg of clothes cleaned

Industrial

Assumptions: 50 percent of industrial machines have carbon adsorbers.

Emission Rate with Carbon Adsorption = 9.5 kg of solvent per 100 kg of clothes cleaned

Emission Rate without Carbon Adsorption = 11.4 kg of solvent per 100 kg of clothes cleaned

Baseline Emission Rate = $(9.5)(0.5) + (11.4)(0.5) = 10.4$ kg of solvent per 100 kg of clothes cleaned

All assumptions and emission rates are based on data from Dow Survey (Dow Chemical, 3 March 1977) and on EPA stack test data (Kleeberg, C. F., 14 May 1976).

3.3.2 Existing and Future Regulations

The baseline emission level is the level of emission control that is achieved by the affected industry in the absence of additional EPA standards. Existing regulations limiting emissions from facilities within the dry cleaning industry are the Federal regulations promulgated by OSHA concerning worker exposure protection, the State Implementation Plans (SIP's), and some local regulations specifically addressing dry cleaning emissions. These regulations now have limited, if any, effect on the baseline emissions. The effects of water and solid waste regulations proposed by EPA on the dry cleaning industry will also be discussed.

3.3.2.1 Existing Regulations. The rules and regulations set by OSHA on dry cleaning solvent vapors were first published in the Federal

Register in August 1971 and have not changed since their original publication. The National Institute for Occupational Safety and Health (NIOSH) supplies OSHA with the information for setting standards to control health hazards in the work place. The current OSHA standards for occupational exposure to perchloroethylene are as follows:

- 100 ppm - 8-hour Time Weighted Average (TWA)
- 200 ppm - Ceiling (may not be exceeded for more than 5 minutes every 3 hours).
- 300 ppm - Peak (never to be exceeded).

OSHA standards could change if more information becomes available on any of the health effects of perc.

3.3.2.2 Future Regulations. In December 1978, a control techniques document (CTG) on Control of Volatile Organic Emissions from Perchloroethylene Dry Cleaning Systems was issued by EPA. This document provides information to State and local air pollution control agencies on reasonably available control technology (RACT) that can be applied to existing perchloroethylene dry cleaning systems. RACT is defined as the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. As specified in the perc CTG, a dry cleaning facility required to meet RACT for perc would have to vent the entire dryer exhaust to a carbon adsorber or equally effective control device. In addition, the facility would be required to eliminate liquid leakage of perc from their system and limit gaseous leakage to a level specified by their State or local air pollution control agency. RACT would limit the perc concentration in the vent from the dryer control device to a maximum of 100 ppm before dilution. Based on CTG guidelines, the facility would also be required to control filter and distillation waste as follows:

(1) Cook or treat the residue from any diatomaceous earth filter so that wastes would not contain more than 25 kg of solvent per 100 kg of wet waste material.

(2) Operate a solvent still so that the residue would not contain more than 60 kg of solvent per 100 kg of wet waste material.

(3) Drain filtration cartridges in the filter housing for at least 24 hours before being discarded.

(4) Any other filtration or distillation system could be used if equivalency to these guidelines is demonstrated. For purposes of equivalency demonstration, any system reducing waste losses below 1 kg solvent per 100 kg clothes cleaned would be considered equivalent under the CTG guidelines.

Revised SIP's for perc dry cleaners are only required in those areas that are in violation of the National Ambient Air Quality Standard (NAAQS) for photochemical oxidants that cannot demonstrate compliance with the NAAQS without applying RACT by July 1982. However, some local counties and municipalities that do not meet EPA's air quality standards or that otherwise believe they have just cause to control solvent emissions have enacted local ordinances. In Arizona, the Maricopa County Bureau of Air Pollution Control requires the use of a vapor adsorber or a condensing system with an inlet temperature of less than 296 K (72°F) for all chlorinated hydrocarbons.

REFERENCES FOR CHAPTER 3

- County Business Patterns 1976, United States Department of Commerce, United States Bureau of the Census, Washington, D.C., U.S. Government Printing Office, September 1977.
- Cunniff, Joseph, Puritan Filters, letter to Kleeberg, Charles F., US EPA, 3 March 1977. Dow Chemical Survey, Anonymous.
- Dees, Edie, TRW, letter to Sluizer, Bud confirming telephone conversation of 19 January 1979, 7 May 1979.
- Fisher, William E., IFI Director of Research, telephone conversation with Dees, Edith, TRW, 19 January 1979.
- Fisher, William E., International Fabricare Institute, "The ABCs of Solvent Mileage" Part One, IFI Special Reporter, No. 3-4, July-August 1975.
- Fisher, William E., IFI Director of Research, telephone conversation with Nunn, Arthur B., TRW, 21 September 1978.
- Gill, Ward, President of National Automatic Laundry and Cleaning Council telephone conversation with Buckwalter, Mary K., TRW, 18 January 1979.
- Kleeberg, Charles F., US EPA, "Material Balance of Industrial Perchloroethylene Dry Cleaner", test report to James F. Durham on test in San Antonio, Texas, 14 May 1976.
- Kleeberg, Charles F., US EPA, "Material Balance of Perchloroethylene Dry Cleaning Unit", test report to James F. Durham on test in Hershey, Pennsylvania, 17 March 1976.
- Kleeberg, Charles F., US EPA, "Material Balance of a Small Commercial Perchloroethylene Dry Cleaner", test report to James F. Durham on test in Kalamazoo, Michigan, 17 May 1976.
- Laundry and Cleaners Allied Trades Association, Inc., letter to Goodwin, D. R., Director, ESED, EPA, 30 November 1978.
- Matthew, Stanley, R. R. Street, Inc., telephone conversation with Buckwalter, Mary K., TRW, 5 November 1978.
- Sluizer, Mervyn, Technical Director of Institute of Industrial Launderers, telephone conversation with Young, Dexter E., TRW, 1 March 1979.
- Victor, Irving, Executive Vice President of VIC Manufacturing Co., telephone conversation with Buckwalter, Mary K., TRW, 1 November 1978.
- Watt, Andrew, IV, and William E. Fisher, "Results of Membership Survey of Dry Cleaning Operation." IFI Special Reporter No. 3-1, January-February 1975.

4. EMISSION CONTROL TECHNIQUES

This chapter discusses control technologies applicable to perc dry cleaners. All possible emission control technologies are evaluated and ranked from the highest to the lowest level of control.

4.1 USE OF CONTROL TECHNIQUES

To a great extent, solvent emissions from perc dry cleaning plants are already controlled through economic necessity. To compete with less expensive petroleum solvents, a substantial degree of solvent recovery is necessary during the drying operation. This is the reason for the use of reclaiming dryers in most perc cleaning establishments. For the same reason, many perc systems are equipped with carbon adsorbers. Carbon adsorbers are now being used by about 35 percent (5,300 facilities) of the commercial systems (Matthews, Stanley, 5 November 1978) and 50 percent (120 facilities) of the industrial systems (Victor, Irving, 1 November 1978).

4.2 TYPES OF CONTROL TECHNIQUES

4.2.1 Solvent Change to a Nonphotochemically Reactive Compound

The greatest reduction of perc emissions would be achieved by eliminating perc completely by changing to another solvent. The only readily available alternative solvents for the first option are trichlorotrifluoroethane (F-113) and petroleum solvents. Petroleum solvents are photochemically reactive, so their use in place of perc would not reduce ozone formation. Research to develop a new source standard for petroleum dry cleaning is now underway. However, petroleum solvents are flammable and are, therefore, regulated by fire codes and insurance regulations. Petroleum solvents may not be allowed in shopping centers due to their flammability. For these reasons, few dry cleaners are expected to use petroleum solvents instead of perc. At present, at least one dry cleaning

solvent, F-113, is not believed to be photochemically active. However, there is some indication that F-113, along with other fluorocarbons, may cause depletion of the upper atmospheric ozone layer. This solvent does not have the same cleaning characteristics as perc and, according to industry spokesmen, may be unsuitable for heavily soiled articles. Also, this solvent, as is the case with petroleum solvent, cannot be used in existing perc equipment. Thus modified and reconstructed perc equipment would have to be replaced with trichlorotrifluoroethane equipment if this control option were promulgated. Trichlorotrifluoroethane equipment is also more expensive than perc equipment, and the solvent itself is three to four times as expensive as perc.

Current fluorocarbon machines are dry-to-dry units. Because fluorocarbons are by far the most expensive of the dry cleaning solvents at \$1.60-\$2.00/kg (\$10-\$12/gal), fluorocarbon machines must show that low solvent consumption is cost-competitive with perc or petroleum machines. Therefore, all fluorocarbon machines have a built-in control device, a refrigeration/condensation system. The fluorocarbon machine recirculates dryer air over a refrigerated condenser (255 K, -18°C), then over electric reheat coils. Expansions or contractions in the stream volumes caused by temperature changes are accommodated by an elastomeric expansion bag on top of the unit. This bag inflates with solvent-laden air as the temperature in the machine increases and collapses as the temperature decreases. Condensed solvent is filtered and distilled for reuse.

4.2.2 Carbon Adsorption

Activated carbon has been used in a variety of applications for the removal of organic compounds from gaseous streams by adsorption. Adsorption is the property of a surface to retain molecules of a fluid with which it has come in contact. The adsorption capacity of a given quantity of carbon varies with different organic compounds and the type of carbon used. Perc can be retained on carbon very easily. The bed capacity (weight of solvent per weight of carbon, expressed as percent) for perc is approximately 20 percent by weight (Barber, J. N., 6 February 1976).

A typical commercial carbon adsorption unit has one carbon canister which is usually desorbed once a day.

A large industrial adsorption unit usually contains multiple canisters so that one can be used while the other is being regenerated. A blower forces the solvent-laden air through one of the adsorbers. Prior to reaching the point of saturation, the flow of air is switched, and the first is desorbed. Desorption is accomplished by passing steam through the carbon bed. The vaporized solvent is picked up by the steam, recovered downstream in a condenser, separated from the water, and then returned to the storage tank.

Carbon adsorption has been used in the perc dry cleaning industry for some time out of economic necessity. Almost all perc systems use condensers to recover losses from the dryer.

Summarized in Table 4-1 are the adsorber inlet and outlet data collected during the source tests. Also in Table 4-2 is a list of the sources controlled by carbon adsorption at each test site. In each case, vapors were drawn from at least the dryer or dry-to-dry machine.

For perc-based units, carbon adsorption can be used to achieve 100 ppm or less outlet concentration. Space requirements vary with the size of the unit. For the three plants tested, the adsorber floor space is shown in Table 4-2. These area estimates include piping, canister, and ductwork. More information on test results is presented in Appendix C.

For a transfer operation, OSHA requires that a current of fresh air be provided at the operator's face while unloading solvent-laden clothes from the washer. This can be accomplished by a fan which draws air through a duct at the machine door lip or by venting through the machine door itself. This solvent-laden airstream is then vented to the carbon adsorber.

Dryers generally vent only at the end of the drying cycle. Dryers may also vent when a thermostat causes cool air to enter an overheated dryer. There is at least one system design in which the dryer vents to an adsorber continuously.

Floor vents are usually installed around the machines and next to storage tank filters in order to collect fugitive emissions and vapors from solvent spills. These vents can be directed to the carbon adsorber

Table 4-1. SUMMARY OF PERC DRY CLEANING TEST DATA^{a-e}

Plant	System	Throughput Kg/day	Total plant emissions	Perc emissions, Kg/100 Kg of clothing				Water separator
				Carbon adsorber outlet	Carbon adsorber inlet	Muck cooker filter or still		
A	Transfer	450	4.1	0.2	4.6	0.73 ^g	0.07	
B	"Kissing" machine	1750	2.5	0.002	7.7	0.38 ^{i,j}	0.026	
C	Dry-to-dry	170	2.1	0.7	23.0 ^k	0.6 ^l	0.001	
D	Dry-to-dry	185	6.6	0.1	3.3	2.73 ^m	----	
E	Dry-to-dry	170	2.6 ^e	----	----	----	----	

^aKleeberg, C. F., 14 May 1976.

^bKleeberg, C. F., 17 May 1976.

^cKleeberg, C. F., 17 March 1976.

^dJongleux, R. F., December 1979.

^eJongleux, R. F., April 1980. Total plant emissions were recalculated based on machine capacity versus actual throughput.

^fBased on machine capacity.

^gMuck cooker/still.

^hWasher drum is vented to atmosphere during loading.

ⁱDistillation unit is vented through a condenser to atmosphere; loss is 0.35 kg/100 kg.

^jOil cooker on still residue; loss is 0.26 kg/100 kg.

^kThis type of system is not widely used in dry cleaning industry. Most use reclaiming dryers.

^lCartridge filter.

^mLow pressure type cartridge filter.

Table 4-2. SUMMARY OF CARBON ADSORBER TEST DATA

Plant	Process (units vented to carbon adsorber)	Clothes cleaned per day, Kg/day	Inlet concentration, ppm	Outlet concentration, ppm	Adsorber efficiency, percent	Estimated size of unit (Floor space) m ² (ft ²)
A	Transfer, commercial (washer door, dryer floor vents, distillation unit vent)	450	600	25	96	3.7 (40)
B	"Kissing" machine industrial (washer door, dryer)	1750	5300-6500	2	99	5.6 (60)
C	Dry-to-dry, commer- cial dry-to-dry machine (dry-to-dry machine door, floor vents)	170	3300	100 ^b	97	1.1 (12)
D	Dry-to-dry, commer- cial machine (dry- to-dry machine)	185	400	11	97	1.5 (16)

^aFor one cycle of adsorption-desorption of a single bed.

^bLimited semicontinuous data show this adsorber to have been underdesigned.

from solvent spills. These vents can be directed to the carbon adsorber as was the case with test plants A and C. There is evidence that these vents are more effective if they are located at the same level as the solvent emissions; perc vapors do not necessarily drop to the floor because the vapor density of the mixture of perc in air is, at most, only about 1.1 times the vapor density of pure air.

There is no technical reason why all perc sources in dry cleaning plants that are currently vented through a stack or duct to the atmosphere cannot be directed to a carbon adsorber. This would include distillation unit vents, washer loading vents, storage tank vents, chemical separators, and floor vents.

As can be seen in Table 4-2, carbon adsorption can result in better than 96 percent emission reduction applied to gas streams seen by the adsorber.

Carbon adsorption presents a special problem for coin-operated systems. There is generally no steam demand at coin-ops and thus no steam boiler. In most cases, the steam necessary to desorb a carbon bed does not exist at these facilities, and necessary space for an adsorber is not available. In order to desorb a carbon bed, a boiler would have to be installed on site for regeneration.

4.2.3 Refrigeration/Condensation

A refrigerated condenser solvent recovery unit provides an alternative to the carbon recovery system. Whereas the carbon system is usually exhausted to the atmosphere, the refrigerated condenser is normally operated as a closed circuit and eliminates the need for external ventilating ducts.

As previously discussed, emissions from a dryer are usually limited to the aeration cycle. A refrigerated condenser works during this cycle as follows: the solvent-laden air from the cleaning machine is cooled to a very low temperature to strip it of solvent and is then recirculated to the air inlet port of the machine. The cooling effect is obtained from a refrigeration unit and is required only during the aeration cycle. This effect drops the temperature of the air below the dew point of the vapor thereby causing it to condense and drain to a water separator. The

recovered solvent is then fed to a storage tank. Test data from one source indicate that refrigeration units on dry-to-dry units can achieve emission rates comparable to a well-operated carbon adsorber equipped facility (Jongleux, R. F., April 1980). Net solvent usage during the test was 10.2 liters, and the plant throughput was 427 kg. Based on these figures, the mass loss rate from the dry cleaning unit was 3.85 kilograms of perc per 100 kilograms of clothes cleaned based on the actual weight of articles cleaned. Based on the machine capacity, the solvent loss rate was 2.6 kilograms per 100 kilograms of articles cleaned. However, it should be understood that these figures are based upon a limited amount of data.

Also, this does not mean that refrigeration units necessarily achieve control equivalent to carbon adsorption units. There are emission points that might be ducted to carbon adsorbers, but that would not be controlled by the refrigeration units. For instance, floor vents that would normally be ducted to a carbon adsorber cannot be vented to a refrigeration system because the bed of packed stoneware used as a heat sink in the system would be heated by the ambient air entering the floor vent. This stoneware is usually cooled during the drying cycle and only exposed to elevated temperatures during aeration. System efficiency would be adversely affected if the stoneware was not at a sufficiently low temperature.

4.2.4 Solvation^{*} Unit

Another possible alternative to the carbon adsorber is the Solvation* unit. This unit has been in use in Europe for approximately 3 years and has been available in the United States for approximately 6 months.

Available information indicates that this unit operates as a closed loop system. The dryer exhaust is ducted to the Solvation unit where perc is condensed and then passes over the cooling coils of its associated dryer before being returned to a solvent storage tank (Weissler, Bill, 22 May 1980). The exact mechanism of operation is not currently known, but one possible explanation for the unit's operation is the use of direct contact condensation when gaseous perc emissions are passed through

* Registered trademark.

water. The unit is guaranteed by the U.S. manufacturer to double the dry cleaner's solvent mileage (Weissler, Bill, 22 May 1980).

4.2.5 Housekeeping

Fugitive emissions caused by poor maintenance of equipment are difficult to quantify. There are two types of fugitive losses, liquid and vapor. Liquid losses can be detected by sight. Vapor leaks above 50 ppm can be detected by smell (Wentz, Manfred, August-September 1973). Below is a list of common emission areas that should be checked periodically to control these losses. This checklist is similar to those used by knowledgeable sources (Hooker Industrial Chemicals, Bulletin Number 185) (Reeves, H. E., January 1969) (VIC Manufacturing Company, Installation and Operation Instruction for VIC Models 221 and 222) to advise perc users on how to maintain equipment.

Liquid leakage areas include:

- a) Hose connections, unions, coupling, and valves.
- b) Machine door gasket and seating.
- c) Filter head gasket and seating.
- d) Pumps.
- e) Base tanks and storage containers.
- f) Water separators (lost in water due to poor separation).
- g) Filter sludge recovery (lost in sludge by improper recovery).
- h) Distillation unit.
- i) Divertor valves.
- j) Saturated lint from lint baskets.
- k) Cartridge filters.

Vapor leakage areas include:

- a) Deodorizing and aeration valves on dryers (the seals on these valves need periodic replacement).
- b) Air and exhaust ductwork (solvent lost through tears in duct).
- c) Doors (doors left open are problems). Leaks in the system should be confined to the closed washer and/or dryer, if possible.
- d) Button traps and lint baskets. These should be opened only as long as necessary.
- e) Open containers of solvent.

- f) Evaporation from wet wash during transfer process.
- g) Removal of articles prior to complete drying.

Other areas include:

- a) Lint screens and bags, fan blades, and condensers. These areas can adversely affect capture systems if they are clogged or caked with lint.
- b) Overloading and underloading dryer can increase losses. Overloading makes drying difficult. Underloading is self-defeating since most losses are fixed in the system.
- c) Inefficient extraction due to overloading or loose belts can overload the dryer.

Rapid detection and repair of leaks is essential in order to minimize solvent losses. Low and moderately priced leak detectors are available and could be used on a regular basis to assist in detecting leaks before they become large enough to see or smell. Monitors are addressed in Appendix D.

4.2.6 Waste Solvent Treatment

Waste solvent is generated by filters in the form of filter muck and by solvent stills in the form of distillation bottoms. The perc content of these wastes can be minimized before disposal by proper treatment. In perc systems, solvent may be "cooked" out of regenerable filter materials in muck cookers. These muck cookers can reduce the amount of solvent lost in filter material by 89 percent (see Table 3-1). Solvent losses from distillation bottom disposal can also be reduced in oil cookers (similar to muck cookers) to levels of about 1 kg/100 kg of wet waste material by proper operation of existing equipment (Kleeberg, C. F., 14 May 1976).

Another option for filtration is cartridge filters. Cartridge filters are applicable to low soil loadings and are used by most coin-op machines and many commercial operations. There are many types of cartridge filters as shown in Table 4-3. In the test data, plant C had a paper cartridge filter with a carbon core. This filter achieved a low emission rate of 0.6 kg of solvent/100 kg of articles cleaned when exposed to the atmosphere. Plant D had a low-pressure-type activated clay cartridge

filter. This filter had an emission rate of 2.7 kg of solvent/100 kg of articles cleaned when exposed to the atmosphere.

Generally, cartridge filters can achieve low emission factors if the manufacturer's recommendations are followed on when to dispose and replace the cartridges. Before disposal these filters should be drained in their housing a minimum of 24 hours to reduce emissions.

There are several filter and still system configurations commonly in use. Filter units and solvent stills are process equipment at cleaners and, therefore, impose no additional space requirements on dry cleaners. Possible configurations are: regenerable filter with a solvent still; disposable filter with a solvent still; disposable filter without a solvent still; and oil cooker with a solvent still. Table 4-3 shows the amount of solvent per 100 kg of wet waste material. These numbers represent well-operated filter and distillation systems as demonstrated by EPA tests.

Centrifugal separation might be an alternative to filtration for recovery of the waste solvent. Although such systems have been utilized for petroleum solvent dry cleaning, there are no data presently available on their applicability to perc dry cleaning.

Table 4-3. FILTER AND DISTILLATION WASTES FROM WELL-OPERATED FACILITIES

Source	kg of solvent/100 kg of wet waste material
Filter System	
Regeneration Tube	25 kg/100 kg ^a
Cartridge	Wide range ^b
Distillation	60 kg/100 kg ^c
Oil Cooker	1 kg/100 kg ^d

^aKleeberg, C. F., 17 March 1976.

^bToo many types of cartridge filters

e.g., Clay - 24.5 kg solvent/100 kg of wet waste material

Carbon Core - 2 kg solvent/100 kg of wet waste material

Activated Clay - 2.7 kg solvent/100 kg of wet waste material

^cFisher, William, 10 May 1979.

^dKleeberg, C. F., 14 May 1976.

REFERENCES FOR CHAPTER 4

- Barber, J. N., Research Director, VIC Manufacturing Company, Minneapolis, Minnesota, letter to Kleeberg, C. F., US EPA, 6 February 1976.
- Fisher, W. E. Director of Research of Internal Fabricare Institute, telephone conversation with Young, Dexter E., TRW, 10 May 1979.
- Fisher, W. E., Director of Research, International Fabricare Institute. Valclene Project Started. Fabricare News. September 1978.
- Hooker Industrial Chemicals, Bulletin Number 185, "Hooker Handbook for Dry Cleaners", Anonymous, p. 10.
- Jongleux, Robert F., "Perchloroethylene Emission Testing at Kleen Korner, New York", TRW, EMB 79-DRY-6, December 1979.
- Jongleux, Robert F., "Material Balance Test Perchloroethylene Refrigerated Closed System, Northvale, New Jersey," TRW, EMB 79-DRY-7, April 1980.
- Kleeberg, Charles F., US EPA, "Material Balance of Industrial Perchloroethylene Dry Cleaner", test report to James F. Durham on test in San Antonio, Texas, 14 May 1976.
- Kleeberg, Charles F., US EPA, "Material Balance of Perchloroethylene Dry Cleaning Unit", test report to James F. Durham on test in Hershey, Pennsylvania, 17 March 1976.
- Kleeberg, Charles F., US EPA, "Material Balance of a Small Commercial Perchloroethylene Dry Cleaner", test report to James F. Durham on test in Kalamazoo, Michigan, 17 May 1976.
- Lundy, Robert, Dow Chemical, letter to Kleeberg, C. F., US EPA, 16 March 1976. Paper entitled "Poor Solvent Mileage - Professional Dry Cleaning Plant".
- Matthews, Stanley, R. R. Street, telephone conversation with Buckwalter, Mary K., TRW, 5 November 1978.
- Reeves, H. E., International Fabricare Institute, "Causes of Excess Loss of Perchloroethylene," IFI Practical Operating Trips Bulletin, p. 91, January 1969.
- VIC Manufacturing Company, "Installation and Operating Instruction for VIC Models 221 and 222," VMC 1195.
- Victor, Irving, Executive Vice President of VIC Manufacturing, telephone conversation with Buckwalter, Mary K., TRW, 1 November 1978.

Weissler, Bill, Diversitron Corporation, letter to Young, D. E., TRW,
22 May 1980.

Wentz, Manfred, International Fabricare Institute, "Dry Cleaning Solvent
Vapors and OSHA," IFI Technical Bulletin No. T-421, August-September
1973.

5. MODIFICATION AND RECONSTRUCTION

In accordance with Section 111 of the Clean Air Act, standards of performance shall be established for new sources within a stationary source category which ". . . may contribute significantly to air pollution . . ." Standards apply to operations or apparatus (facilities) within a stationary source, selected as "affected facilities," that is, facilities for which applicable standards of performance have been promulgated and the construction or modification of which commenced after the proposal of said standards.

On December 16, 1975, the Agency promulgated amendments to the general provisions of 40 CFR Part 60, including additions and revisions to clarify modification and the addition of a reconstruction provision. Under the provisions of 40 CFR 60.14 and 60.15, an "existing facility" may become subject to standards of performance if deemed modified or reconstructed. An "existing facility" defined in 40 CFR 60.2(aa) is an apparatus of the type for which a standard of performance is promulgated and the construction or modification of which was commenced before the date of proposal of that standard. The following discussion examines the applicability of these provisions to perc dry cleaning facilities and details conditions under which existing facilities could become subject to standards of performance. It is important to stress that since standards of performance apply to affected facilities, which combined with existing and other facilities comprise a stationary source, the addition of an affected facility to a stationary source through any mechanism, new construction, modification, or reconstruction, does not make the entire stationary source subject to standards of performance; but rather only the added affected facilities are subject to these standards.

5.1 40 CFR PART 60 PROVISIONS FOR MODIFICATION AND RECONSTRUCTION

5.1.1 Modification

It is important that these provisions be fully understood prior to investigating their applicability.

Section 60.14 defines modification as follows:

"Except as provided under paragraphs (d), (e) and (f) of this section, any physical or operational changes to an existing facility which result in an increase in emission rate to the atmosphere of any pollutant to which a standard applies shall be a modification. Upon modification, an existing facility shall become an affected facility for each pollutant to which a standard applies and for which there is an increase in the emission rate."

The exception in paragraph (d), as interpreted by the Court in the case of ASARCO vs. EPA in January 1978, is limited by the ruling that any operational change which results in an increase in emissions from an individual unit or facility would be considered a modification and would be subject to NSPS.

Paragraph (e) lists certain physical or operational changes which will not be considered as modifications, irrespective of any change in the emission rate. These changes include:

1. Routine maintenance, repair, and replacement;
2. An increase in the production rate not requiring a capital expenditure as defined in Section 60.2(bb);
3. An increase in the hours of operation;
4. Use of an alternative fuel or raw material if, prior to the standard, the existing facility were designed to accommodate that alternate fuel or raw material; and
5. The addition or use of any system or device whose primary function is the reduction of air pollutants, except when an emission control system is removed or replaced by a system considered to be less efficient.

Paragraph (b) clarifies what constitutes an increase in emissions in kilograms per hour and the methods for determining the increase, including the use of emission factors, material balances, continuous monitoring

systems, and manual emission tests. Paragraph (c) affirms that the addition of an affected facility to a stationary source does not make any other facility within that source subject to standards of performance. Paragraph (f) simply provides for superseding any conflicting provisions.

5.1.2 Reconstruction

Section 60.15 regarding reconstruction states:

"If an owner or operator of an existing facility proposes to replace components, and the fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable entirely new facility, he shall notify the Administrator of the proposed replacements. The notice must be postmarked 60 days (or as soon as practicable) before construction of the replacements is commenced"

The purpose of this provision is to ensure that an owner or operator does not perpetuate an existing facility by replacing all but vestigial components, support structures, frames, housing, etc., rather than totally replacing it in order to avoid subjugation to applicable standards of performance. As noted, upon request, EPA will determine if the proposed replacement of an existing facility's components constitutes reconstruction.

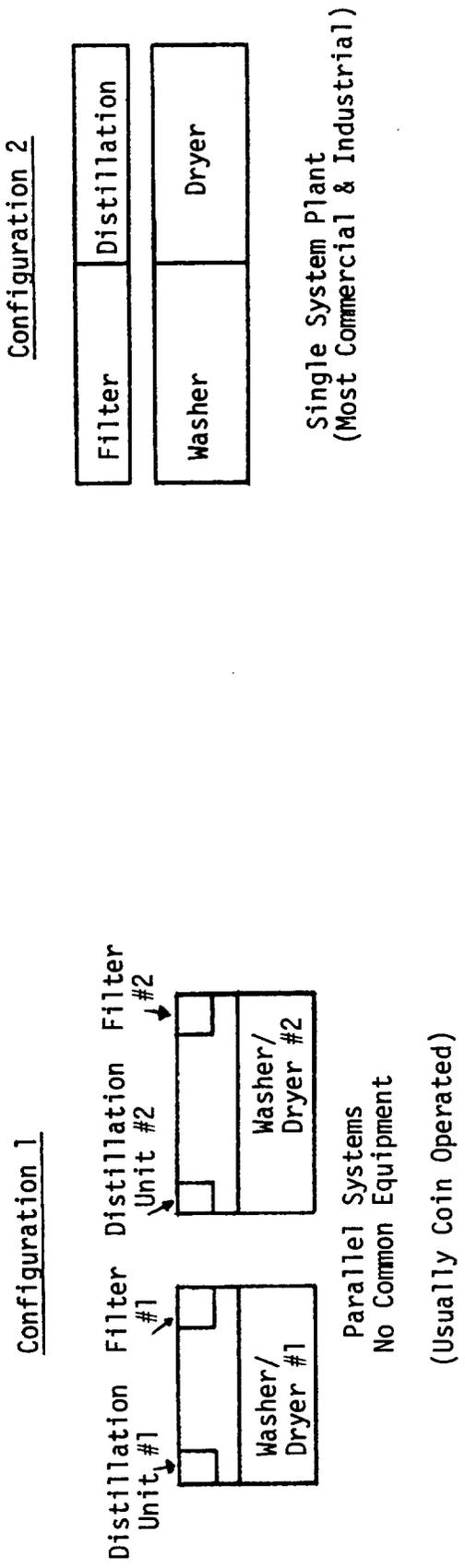
5.2 APPLICABILITY TO PERCHLOROETHYLENE DRY CLEANING FACILITIES

The purpose of this section is to outline some of the most probable types of "modifications" to existing plants and to describe the applicability of the term "reconstruction" to this industry.

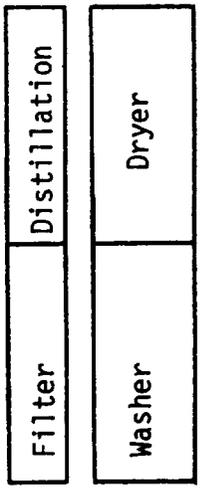
Typical dry cleaning plant equipment configurations are shown in Figure 5-1. These are parallel systems, single systems, and interdependent systems. Almost all coin-operated plants are parallel systems. Most commercial and industrial plants would be of the single system configuration. The third configuration, an interdependent system, occasionally occurs in the industrial and commercial sectors of the industry. Multiple washers are used with multiple dryers without having particular dryers necessarily dedicated to any particular washer. Because of difference in solvent characteristics, however, such a plant would use only one type of solvent.

5.2.1 Modification

Modification of an existing facility that would cause an increase in emissions is deemed unlikely, however, some possible changes to the dryer

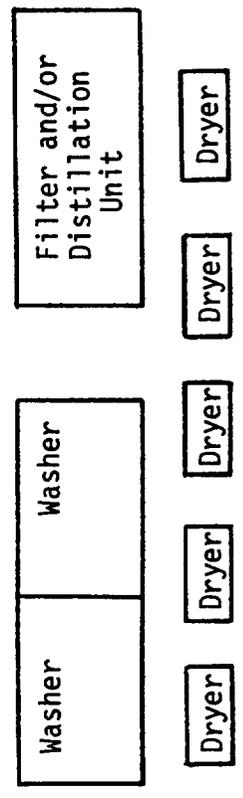


Configuration 2



Single System Plant
(Most Commercial & Industrial)

Configuration 3



Interdependent System (Use Same Solvent)
Dryers, Distillation, and Filter are Common
to both Washers

Figure 5-1. Plant configurations encountered in the dry cleaning industry.

or dry-to-dry machine could result in an increased emission rate. For instance, disabling the damper that prevents perc leaking into the exhaust during the reclaim cycle could result in increased emissions. Similarly, either reducing cooling water flow to the condenser in a reclaiming dryer or replacing the cooling coils with less efficient coils could increase the emission rate. Reducing the drying temperature without increasing the drying time could also result in an increased emission rate. Although these changes could result in increased emission rates, the actual designation of any such change as a modification would be made on a case-by-case basis.

5.2.2 Reconstruction

Replacement of a dryer or dry-to-dry machine constitutes establishment of a new facility. Therefore, reconstruction would consist of major repairs or modifications which would exceed 50 percent of the fixed capital cost of a new dryer or dry-to-dry machine. However, such changes are not usually undertaken in this industry. Although dryers last about 30 years, the replacement of the dryer drum or condensers coils could possibly exceed 50 percent of the total cost. Such reconstructed dryers would be subject to the standard.

6. MODEL PLANTS AND REGULATORY ALTERNATIVES

The purpose of this chapter is to define the model plants and regulatory alternatives. Model plants defined in this chapter are parametric descriptions of the type of plants that in EPA's judgment will be constructed, modified, or reconstructed. Model plant parameters are used as a basis to estimate the environmental, economic, and energy impacts associated with the application of the regulatory alternatives defined in section 6.2 of this chapter.

6.1 MODEL PLANTS

Model plants have been designated for each of the three industry categories to facilitate the estimation of control costs for the industry. For commercial operations, two sizes of plants were costed to show the range of costs in that category. The model plants are specified by their major characteristics; machine capacity, the number of loads cleaned per day, cycle time, number of days of operation per year, and the number of machines per plant. The model plant parameters chosen for this study are tabulated in Table 6-1.

6.1.1 Coin-Op

The parameters for the model coin-operated dry cleaning plant are based on information obtained from industry comments and equipment vendors. An average number of loads per day was calculated from the total receipt, (County Business Patterns 1976, September 1977) for this section of the industry, the number of plants (County Business Patterns 1976, September 1977), the average cost per pound of clothes (Gill, Ward A., 18 January 1979), the usual machine size, and the actual number of machines per plant (Gill, Ward A., 2 March 1977). The cycle time is taken from equipment vendors literature (Multimatic Corporation, undated). Since the equipment is used by the public, 312 days of operation per year was used.

Table 6-1. MODEL PLANT PARAMETERS FOR THE PERC DRY CLEANING INDUSTRY

	Coin-op	Commercial	Commercial	Industrial
Machine capacity	3.6 kg (8 lbs)	11 kg (25 lbs)	23 kg (50 lbs)	113 kg (250 lbs)
Cycle time, minutes	23	57 ^a	57 ^a	35
Loads per day	4.0 ^b	4.9 ^c	4.9 ^c	16.6
Days of operation/ year	312	250	250	250
Number of machines/ plant	2	1	1	1
Kilogram clothes/ year (lbs/yr)	8,986 (19,811)	13,475 (29,707)	28,175 (62,116)	468,950 (1,034,000)

^aFor dry-to-dry machines, transfer operation can cycle in 35 minutes.

^bFor each of two (2) machines in a plant.

^cAverage for transfer and dry-to-dry operations.

6.1.2 Commercial

About 25 percent of commercial machines are dry-to-dry type machines and the remaining 75 percent are transfer machines. Two machine sizes, 11 kg (25 lbs) and 23 kg (50 lbs), were chosen to cover the range of plants in this sector of the industry. The average number of loads (4.9) was calculated from data on the number of plants and the total throughput. The cycle time given (57 min) is based on the time needed for good quality cleaning (Landon, Steve, 25 February 1977) and an average work year of 250 days was assumed.

6.1.3 Industrial

The average number of loads per day (16.6) for the industrial sector of the industry was calculated in a manner similar to the other two sectors of the industry. Throughput was divided by the number of plants (County Business Patterns 1976, September 1977) to obtain an average throughput per plant of 468,950 Kg of clothes per year. An average machine size of 250 lbs was taken from industry comments (Sluizer, Mervyn, 4 May 1977). An average work year of 250 days per year was assumed.

6.2 REGULATORY ALTERNATIVES

The purpose of this section is to define various regulatory alternatives or possible courses of action EPA could take to abate perc emissions from dry cleaning operations. Within each regulatory alternative, the control technique for each industry category was chosen based on the appropriateness of the cost of control and the emission reduction potential for each category. The base case, no additional regulations, is also included to show the effects of existing regulations and market forces.

Table 6-2 presents these control options and specifies the control techniques to be used for each segment of the industry. The projected emissions from each segment of the industry after the application of the control options, the rationale for their choice, and the derivation of emissions are given below.

6.2.1 Control Option 1

This option is technically the highest level of emission control for the coin-op and commercial industries, no emissions of perc would be

Table 6-2. CONTROL OPTIONS

Control option	Coin-op	Commercial	Industrial
1	Non-photochemically reactive solvent equipment	Non-photochemically reactive solvent equipment	Option 1 is the same as option 2
2	Quickly identify and repair all leaks Regenerative filter wastes should not exceed 25 kg of solvent per 100 kg of wet waste materials Distillation wastes should not exceed 60 kg of solvent per 100 kg of wet waste materials Cartridge filters should be drained in their housing for at least 24 hours prior to disposal	Carbon adsorption applied to washer and dryer or dry-to-dry machine and still and muck cooker vents Quickly identify and repair all leaks Regenerative filter wastes should not exceed 25 kg of solvent per 100 kg of wet waste materials Distillation wastes should not exceed 60 kg of solvent per 100 kg of wet waste material Cartridge filters should be drained in their housing for at least 24 hours prior to disposal	Carbon adsorption applied to washer and dryer or dry-to-dry machine and still and muck cooker vents Quickly identify and repair all leaks Regenerative filter wastes should not exceed 25 kg of solvent per 100 kg of wet waste materials Distillation wastes should not exceed 60 kg of solvent per 100 kg of wet waste material Cartridge filters should be drained in their housing for at least 24 hours prior to disposal
3	This option would require no further control other than that being established by state or local agencies	This option would require no further control other than that being established by state or local agencies	This option would require no further control other than that being established by state or local agencies

permitted. Other solvents that would be used are petroleum solvents and F-113. For this option, it was assumed that F-113 would be used since petroleum solvents may be regulated as a VOC in the future while F-113 does not contribute significantly to oxidant formation. The rapid, low temperature drying characteristics of F-113, together with its gentle solvent properties, make it useful for cleaning such delicate items as leather. There is some indication that F-113, along with other fluorocarbons, may cause depletion of the upper atmospheric ozone layer. This reduction in the capacity of the ozone layer to filter ultraviolet rays from the sun could lead to an increase in the occurrence of skin cancer. However, F-113 currently has the highest Threshold Limit Value (1000 ppm) of any of the common dry cleaning solvents (indicating lowest health hazard), which makes it applicable to non-professional operators, such as coin-operated cleaners. As a consequence of these principal areas of use, most fluorocarbon machines are of relatively small capacity. The most common size appear to be 5.5 kg (12 lb) and 11.5 kg (25 lb). There does not appear to be any reason why units could not be built for larger capacity, but use in certain commercial operations and most industrial operations has been questioned principally because of the necessity to remove water soluble soils and larger quantities of grease and oil. It is asserted that F-113 and water are incompatible (Lester, R.E., 24 March 1977). For these reasons, F-113 was not chosen as a control option for the industrial segment.

For the industrial sector, carbon adsorption would be required for all affected facilities. The carbon adsorber would be required to collect emissions from dryer or dry-to-dry machines. The industrial sector would be required to eliminate all significant leaks of solvent. Facilities would be forced to repair or replace malfunctioning equipment. Industry sources and EPA tests have, however, established that a well maintained plant will control its fugitive emissions to 1 to 2 kg of perc per 100 kg of clothes cleaned. This is approximately 25 percent of the projected emissions from a regulated commercial or industrial dry cleaner. Vapor leaks would be controlled by inspection and maintenance.

The industrial sector would be required to reduce the air emissions associated with their regenerable filter wastes by cooking or treating so

that these wastes shall not contain more than 25 kg of solvent per 100 kg of wet waste material. The residue from a solvent still shall not contain more than 60 kg of solvent per 100 kg of wet waste material. Longer cooking times for filter muck and longer distillation times for distillation units should ensure meeting these waste solvent levels. Any other filtration or distillation system can be used if equivalency to these levels is demonstrated. Any system reducing waste losses below 1 kg solvent per 100 kg clothes cleaned will be considered equivalent. For a large industrial operation oil cookers (similar to muck cookers) are sometimes used. Solvent losses from distillation bottom disposal can be reduced in oil cookers to levels well below 1 kg/100 kg of clothes cleaned by proper operation of existing equipment according to a test conducted by EPA (Kleeberg, Charles F., 14 May 1976).

6.2.2 Control Option 2

For the coin-op industry, option 2 would require that the plant be well maintained and well operated, i.e., good housekeeping. For the commercial and industrial sectors, carbon adsorption or an equivalent control technology would be required for affected facilities whether they are dry-to-dry or transfer operations. The carbon adsorber or an equivalent technology would collect emissions from the washer and dryer or dry-to-dry machine. All industrial and commercial sectors would be required to eliminate all significant leaks of solvent. Facilities would be required to repair or replace malfunctioning equipment within 3 working days or have a purchase order on hand within 3 working days showing the required replacement parts have been ordered.

All industry sectors would be required to reduce the air emissions associated with their filter and distillation wastes. The residue from any diatomaceous earth filter shall be cooked or treated so that wastes shall not contain more than 25 kg of solvent per 100 kg of wet waste material. The residue from a solvent still shall not contain more than 60 kg of solvent per 100 kg of wet waste material. Longer cooking times for filter muck and longer distillation times for distillation units should ensure meeting these waste solvent levels. Cartridge filters must be drained in their filter house for at least 24 hours before being discarded.