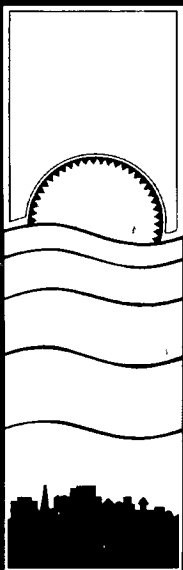




Canadian Council Le Conseil canadien
of Ministers des ministres
of the Environment de l'environnement

ENVIRONMENTAL CODE OF PRACTICE FOR THE REDUCTION OF SOLVENT EMISSIONS FROM COMMERCIAL AND INDUSTRIAL DEGREASING FACILITIES



PN 1182

CCME MANAGEMENT PLAN
INITIATIVES V309 AND V614
JUNE 1995

The Canadian Council of Ministers of the Environment (CCME) is the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international and global concern. The 14 member governments work as partners in developing nationally consistent environment standards, practices and legislation.

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CCME Documents
c/o Manitoba Statutory Publications
200 Vaughan St
Winnipeg, Manitoba, Canada R3C 1T5
Phone 1-800-805-3025
Fax 204-945-7172
e-mail spccme@chc.gov.mb.ca

It is the intent of CCME to update this Code of Practice periodically so that it remains current and reflects the most recent technological advances.

Comments regarding the content of this Code of Practice and the contribution of material developed to implement it would be greatly appreciated. A master file containing comments and submissions of new material will be maintained by Environment Canada. Please send your contributions to

Chief, Chemical Industries Division
Industrial Sectors Branch
Environment Canada
Ottawa, Ontario K1A 0H3
Tel (819) 997-3640
Fax (819) 953-5595

Prepared by the National Task Force
on the Reduction of Solvent Emissions for
Commercial and Industrial
Degreasing Facilities

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Abstract

The purpose of this Code is to provide guidance to environmental regulatory agencies, manufacturers and operators concerning means of reducing solvent emissions containing volatile organic compounds (VOCs) from degreasing facilities. It provides a basis for implementing consistent and uniform control measures and operating standards for commercial and industrial degreasing facilities across Canada.

Organic solvent cleaning does not constitute a distinct industrial category and solvent degreasers are an integral part of many industrial sectors. This Code is written for those operating sites that are unable for technical or economic reasons to convert to degreasing systems that eliminate the use of organic solvents and continue to use solvent degreasing technology in their manufacturing operations. It applies to all persons who own or operate batch-loaded or conveyORIZED cold cleaners, open-top or conveyORIZED vapour degreasers, remote reservoir cold cleaners or parts washers and who carry out solvent cleaning operations with a solvent containing VOCs.

The Code contains design, equipment and operating standards for existing and new degreasing facilities, record keeping and training standards and typical operating procedures. A self-assessment questionnaire is also included to assist the owner and authorities in identifying the most significant emission sources from a given operation.

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Glossary

Agitation is any operation that uses mechanical or physical means to increase turbulence for improved cleaning effectiveness, thereby increasing the convection and diffusion losses of the solvent

Air-Solvent Interface is the point of contact between the exposed liquid solvent in the degreaser and the air

Air-Solvent Interface Surface Area is the geometric surface area of the liquid solvent contained in the degreaser

Air-Vapour Interface is the point of contact between the exposed solvent vapour in the degreaser and the air

Air-Vapour Interface Surface Area

- (a) for **Open-Top Vapour Degreasers** is the geometric surface area of the open top of the degreaser
- (b) for **Conveyorized Degreasers**, is the combined geometric surface areas of the projected plane surfaces of all degreaser openings

Batch-Loaded Cold Cleaner is a degreaser that is designed to contain liquid solvent at a temperature below its boiling point and is used for cleaning objects in a batch-type operation

Bi-Parting Cover is an automated cover for a solvent cleaning machine consisting of two halves, the movement of which is in the horizontal plane, is coordinated with the entry and removal of parts to and from the degreaser and is designed to close around the hoist cables during the cleaning cycle

Cold Cleaning is the batch process of cleaning and removing soils from a surface by spraying, brushing, flushing or immersing while maintaining the solvent below its boiling point. Wipe cleaning is not included in this definition

Condenser Water Flow Switch is a safety switch that turns off the sump heat if condenser water fails to circulate or rises above the designed operating temperature

Conveyorized Degreaser is any degreaser that uses an integral, continuous, mechanical system for moving materials or parts to be cleaned into and out of a solvent liquid or vapour cleaning zone

Degreaser is any equipment designed and used for holding a solvent to carry out solvent cleaning operations. Degreasers include batch-loaded cold cleaners, open-top vapour degreasers, conveyorized degreasers and remote reservoir cold cleaners

Degreasing refers to processes that use non-aqueous solvents to remove soils from surfaces of parts, products, machinery and equipment by dissolving or dispersing them with organic compounds that do not adhere to the surface being cleaned

Down-Time Cover is an apparatus or cover that prevents the escape of solvent vapours when the degreaser is not in use

Drag-Out is solvent carried out of a degreaser that adheres to or is entrapped in, the material or parts being removed

Drying Tunnel is an add-on enclosure extending from the exit area of a conveyORIZED degreaser. It is designed to reduce drag-out losses by containing evaporated solvent

Dwell is the period of time a cleaned article remains in the freeboard zone of a degreaser to allow solvent to drain from the cleaned article back into the degreaser

Emulsion Cleaner is a liquid that contains a VOC-containing solvent suspended in water

Existing Degreaser is a degreaser and its related equipment manufactured on or before December 31, 1995

Flow Solvent Cleaning is a technique to increase the effectiveness of dissolving contaminants on the surface of a part by moving solvent over it

Freeboard Height

- (a) for **Batch-Loaded Cold Cleaners**, is the distance from the top of the solvent to the top of the tank
- (b) for **Open-Top Vapour Degreasers**, is the distance from the air-vapour interface to the top of the tank
- (c) for **Conveyorized Degreasers**, is the distance from the air-solvent or air-vapour interface to the bottom of the entrance or exit opening, whichever is lower

Freeboard Ratio is the freeboard height divided by the smallest inside length, inside width or inside diameter of the degreaser tank

Freeboard Zone is the space above the air-solvent or air-vapour surface area of a degreaser between the upper and lower planes that define the freeboard height of the degreaser

Ghosting is the formation of a dense white fog in the vapour zone of a vapour degreaser caused by water contamination of the solvent. The terms "clouding" and "fogging" are also used to describe this phenomenon

High-Volatility Solvent is any solvent that is not classified as a low-volatility solvent. A low-volatility solvent is considered to be a high-volatility solvent if it is agitated in a way that breaks the surface of the solvent in the liquid bath, or if it is sprayed or heated to within 100°C (180°F) of its true boiling point during the degreasing cycle.

Lip Exhaust is a system that draws air laden with solvent vapours from the top of the degreaser tank's perimeter and carries it away from operating personnel to reduce occupational exposures.

Low-Volatility Solvent is a solvent that has an initial boiling point greater than 120°C (248°F) and whose initial boiling point exceeds the maximum operating temperature of the solvent cleaning operation by at least 100°C (180°F).

Manual Cover is a manually operated cover of the roll-top or canvas curtain type or any other cover that slides off the degreaser in the horizontal plane and can be opened or closed without disturbing the vapour layer or solvent surface.

New Degreaser is a degreaser and its related equipment manufactured after December 31, 1995.

Open-Top Vapour Degreaser is any batch-loaded solvent degreaser using condensation of hot solvent vapour to clean and remove soils from parts.

Person is any firm, business establishment, association, partnership, corporation or individual, whether acting as principal, agent, employee or in another capacity, including any government entity or charitable organization.

Refrigerated Freeboard Chiller is an emission control device that is mounted above the water jacket or primary condenser coils. It consists of secondary coils that carry a refrigerant to provide a chilled air blanket above the solvent vapour to reduce emissions from the degreaser bath.

Remote Reservoir Cold Cleaner (Parts Washer) is any device in which liquid solvent is pumped through a sink-like work area that drains back into an enclosed container while parts are being cleaned.

Rotating Basket is a perforated or wire mesh cylinder that contains parts to be cleaned and is slowly rotated while proceeding through the degreaser.

Soils include but are not limited to uncured coatings, adhesives, inks and contaminants such as dirt, oil and grease.

Solvent is any non-aqueous organic liquid used to clean and remove soils from surfaces in a degreasing operation. Solvents include petroleum distillates, aliphatic hydrocarbons, chlorinated hydrocarbons, ketones, alcohols, esters, glycol ethers and terpenes. They are used alone or in blends to remove water-insoluble soils for cleaning purposes and to prepare materials or parts for painting, plating, repair, inspection, assembly, heat treatment or machining.

Solvent Cleaning Operation is the removal of adhesives, inks, uncured coatings and contaminants, which include, dirt, soil, oil and grease from parts, products, tools, machinery and equipment

Solvent Container is that part of the degreaser that is intended to hold the cleaning solvent

Spray Pump Control Switch is a safety switch that prevents the spray pump from operating without an adequate vapour level

Solvent Recovery Still is a covered tank or vessel designed to remove contaminants from used degreasing solvents so that they can be reclaimed and reused. This is accomplished by boiling the contaminated solvent, condensing the resultant contaminant-free vapour, and finally passing the distillate through a water separator

Vapour Level Control Switch is a safety switch that turns off the sump heat when the solvent vapour level rises above the designed operating level

Volatile Organic Compound (VOC) is any organic compound that participates in atmospheric photochemical reactions, that is, any such organic compound other than the following which have been excluded because of their negligible photochemical reactivity

Methane

Ethane

1,1,1 - Trichloroethane (Methyl Chloroform)

Methylene Chloride (Dichloromethane)¹

Chlorofluorocarbons (CFCs)

Fluorocarbons (FCs)

Hydrochlorofluorocarbons (HCFCs)

Wipe Cleaning is a cleaning method in which a cloth or other material is wetted with a solvent and rubbed on a surface to remove soils

Workload Area is

- (a) the plane geometric surface area of the top of the submerged parts basket, or
- (b) the combined plane geometric surface area(s) displaced by the submerged part(s) in the degreaser, if no parts basket is used

Work Capacity is the load a degreaser is designed to process efficiently while maintaining a steady vapour level

¹ Dichloromethane has been assessed under the *Canadian Environmental Protection Act* and found to be "toxic"

Abbreviations

ASTM	American Society for the Testing of Materials (U S)
BACTEA	Best Available Control Technology Economically Achievable
CCME	Canadian Council of Ministers of the Environment
CEPA	<i>Canadian Environmental Protection Act</i>
CFCs	Chlorofluorocarbons
EPA	Environmental Protection Agency (U S)
FCs	Fluorocarbons
HCFCs	Hydrochlorofluorocarbons
ISTC	Industry, Science and Technology Canada (now Industry Canada)
LFV	Lower Fraser Valley
MSHA	Mine, Safety and Health Administration (U S)
NESHAP	National Emission Standards for Hazardous Air Pollutants (U S)
NIOSH	National Institute of Occupational Safety and Health (U S)
NO_x	Nitrogen Oxides
PPG	PPG Industries Inc
PSL	Priority Substance List (CEPA)
SCAQMD	South Coast Air Quality Management District (California)
VOCs	Volatile Organic Compounds
WHMIS	Workplace Hazardous Materials Information System
WQC	Windsor-Quebec City Corridor

Units of Measure

%	Percent
C	Centigrade, temperature scale
F	Fahrenheit, temperature scale
m	metre
cm	centimetre
ppb	parts per billion
psig	pounds per square inch gauge, a unit of pressure

Preface

Ground-level ozone is produced when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the atmosphere in the presence of sunlight. It is a major component of urban smog. At elevated levels, it is known to decrease lung function, cause premature aging of the lungs and damage vegetation, including some agricultural crops and forest species.

Ground-level ozone is one of the more serious air quality problems in Canada today. Concentrations sometimes reach more than twice the Canadian maximum acceptable objective of 82 parts per billion (ppb) in the summer months. The problem is most acute in urban centres, especially in the Lower Fraser Valley (LFV) of British Columbia and the Windsor-Quebec City Corridor (WQC).

Recognizing the problem, the Canadian Council of Ministers of the Environment (CCME) initiated the development of a *Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOC)* for Canada to reduce the formation of ground-level ozone by controlling the emissions of volatile organic compounds and nitrogen oxides.

This plan identifies commercial and industrial degreasing facilities as a source of VOC emissions in Canada. VOC emissions from solvent cleaning facilities were estimated to exceed 17 kilotonnes in 1985. Without controls these are expected to increase to 19.1 kilotonnes by 2005. The plan estimated that an 80 percent reduction in emissions could be achieved for new degreasing facilities built in 1995 or after, and that an average 50 percent reduction in the emissions forecast for the year 2005 was possible for existing facilities.

The plan sets out 58 specific initiatives to reduce NO_x and VOC emissions from existing and new sources. Initiative V309 recommends the development of a CCME Environmental Code of Practice, including new source performance standards for commercial and industrial degreasing facilities, effective 1995. Initiative V614 refers to retrofitting existing commercial and industrial degreasing facilities in the Lower Fraser Valley and the Windsor-Quebec City Corridor by 1997. This Code of Practice is in response to and in support of these initiatives. The Code will be made available to the provinces for implementation purposes.

The Code was developed by a multi-stakeholder task force made up of representatives from federal, provincial and municipal governments, solvent and equipment suppliers, relevant industrial associations and environment non-government organizations. Appendix A contains a list of Task Force members. The contributions of all participants and stakeholders who helped develop this Code are gratefully acknowledged.

This Code is based primarily on information contained in the following documents

- (1) EPA's Proposed National Standards for Hazardous Air Pollutants *Halogenated Solvent Cleaning*, 40 CFR Part 63, November 29, 1993
- (2) California's Rule 1122, as amended April 5, 1991
- (3) *Solvent Cleaning (Degreasing)* published by the Center for Emissions Control, Washington, D C , November 1992
- (4) *ASTM Manual on Vapour Degreasing*, Third Edition, June 1989
- (5) *Vapour Degreasing*, published by PPG Industries Inc , 1992

Development was also guided by information contained in the following documents

- (6) U S EPA Staff Working Document, *Model Volatile Organic Compound Rules for Reasonably Available Control Technology*
- (7) Michigan Rules 336 1611 through 336 1614, January 1980
- (8) U S EPA, Office of Air Quality, Planning and Standards *Overview of the Halogenated Solvent Cleaning/Degreasing*, NESHAP, Almodovar, A P , October 1992
- (9) U S EPA, Office of Air Quality, Planning and Standards, *Organic Solvent Cleaner Characteristics and Emissions*, October 1992
- (10) *ASTM Manual on Cold Cleaning with Halogenated Solvents*, ASTM Publication Code Number 04-403010-15, November 1981
- (11) *Economical and Efficient Vapour Degreasing with Chlorinated Solvents from Dow* a Dow Chemical Company publication, 1987

Introduction

Solvent degreasing involves the use of organic solvents, in either the liquid or vapour phase, to remove soils such as cutting oils, metal particles, soldering fluxes and waxes from fabricated articles. Degreasing of articles is generally carried out prior to their final use, as in the case of printed circuit boards, or prior to subsequent treatment, such as plating or painting. This cleaning is necessary and in some instances is required, e.g. military specifications, to ensure a consistently high quality of components or parts, or to prepare surfaces in order to ensure good bonding between surface coating or plating materials and the manufactured articles.

Organic solvent cleaning does not constitute a distinct industrial category, and solvent degreasers are an integral part of many industrial sectors. This Code, therefore, applies to all persons in any industrial or commercial sector who own or operate "new" or "existing" degreaser facilities² and who carry out solvent cleaning operations with a solvent containing volatile organic compounds (VOCs).

The owner/operator of a solvent degreasing facility will realize a number of benefits by implementing this Code: in addition to reducing discharges of solvent to the environment, lower costs from reduced solvent use, reduced waste generation and more consistent product quality should make plant operations more efficient. Reduced emissions, if properly applied, should improve both workplace environment and health and safety protection for workers. These factors should all improve the facility's community relations and competitive position.

The Code is written in four parts to facilitate implementation and decision making:

PART I defines the application and scope of the Code

PART II defines design, equipment and operating standards for new solvent degreasers and for retrofitting existing degreasing facilities

PART III identifies record-keeping and test method standards that will assist owners and authorities to gauge compliance and operating efficiency

PART IV identifies the important elements of an operator training program

² The CCME NO_x/VOC Management Plan identifies the following implementation schedule:

- New source performance standard for commercial/industrial degreasing facilities, effective 1995, and
- Retrofit of existing commercial/industrial degreasing operations in the LFV and WQC to BACTEA (Best Available Control Technology Economically Achievable) by 1997

The information in this Code is intended to be useful in minimizing VOC-containing solvent emissions to the atmosphere. In implementing this Code, however, care must be taken not to compromise the safety or the health of workers or the community. It is recommended that the degreaser operator contact the agency responsible for occupational health and safety in his/her area to ensure that any changes contemplated meet their requirements.

It is an individual company's responsibility to determine the appropriate policies, standards and procedures that are required to conform to all applicable health, safety and environmental laws and regulations, now and in the future.

Appendices

The appendices include additional background data, explanations of various items and issues, reference tables, sample forms and typical operating procedures to assist in the interpretation and implementation of this Code of Practice. A self-assessment questionnaire (Appendix B) is also included to assist the owner and authorities in identifying the most significant emission sources from a given operation and in setting priorities.

Trends in Solvent Use

The different solvents that have traditionally been used in the solvent degreasing process have different characteristics with respect to their cleaning effectiveness and their inherent health, safety and environmental hazards. Hydrocarbon solvents have been used extensively in degreasing operations for many years. Their low flash points, however, introduced a major safety concern into the workplace and resulted in a significant switch to the non-flammable chlorinated solvents.

While the stability and solvency of chlorinated hydrocarbons render them desirable solvents for almost all cleaning applications, their use has raised other concerns. Some solvents are considered to be VOCs and will be subject to CCME's NO_x/VOC Management Plan initiative. The toxicity of other VOCs (see listing below) may introduce hazards into the workplace.

The following degreasing solvents have been assessed and determined to be "toxic" as defined by Section 11 of the *Canadian Environmental Protection Act* (CEPA)

Dichloromethane [Methylene Chloride]
Tetrachloroethylene [Perchloroethylene]
Trichloroethylene

Strategic Option Reports, aimed at reducing emissions, will be developed covering all significant sources of these substances.

Because of their low toxicity and desirable cleaning characteristics, the use of other chlorinated hydrocarbons such as CFC-113 and methyl chloroform has grown over the past three decades. Recently, however, these compounds were identified as contributing to stratospheric ozone layer depletion. As a result, they are being phased out under the Montreal Protocol.

Health, safety and environmental concerns have led to the development of low-volatility solvents and alternative degreasing processes that reduce or eliminate the use of solvents altogether. Aqueous and semi-aqueous cleaning systems have been developed that provide adequate cleaning for many, but not all, applications. Advantages include the reduction or elimination of VOC emissions and, in general, a safer and healthier workplace. Disadvantages include the need for rinsing (which results in unwanted residues), increased floor space and higher energy costs as a result of necessary additional drying, incompatibility with some materials, and the need for wastewater treatment and disposal. Despite these considerations, many companies have made the decision to convert from solvent to aqueous or semi-aqueous cleaning systems. This trend is expected to continue.

Additional information on degreasing agents, degreasing technology, and types of systems, is included in the reference document entitled *VOC Emissions from Solvent Degreasing*, prepared for Environment Canada by Energy Pathways Inc. in conjunction with H.W. Quinn Associates.

The bottom line is that available options must be evaluated for cleaning in terms of effectiveness, capital and operating costs, workplace health and safety risks, existing or pending regulations and environmental concerns. In doing this, operators should critically consider how clean the parts and components really need to be to meet all applicable specifications. Often it has been found that excessive cleaning (and VOC emissions) are a matter of habit and not necessity. Also, in selecting any solvent system, occupational health and safety and all environmental concerns must be considered simultaneously.

Characteristics of Management Systems

Experience has shown that the application of well-thought-out health, safety and environmental management systems is a good way of meeting both economic and environmental constraints. To be effective, these management systems should have a specified scope and should be capable of demonstrating that

- the system is understood, effective and implemented,
- the performance criteria satisfy all applicable legal requirements as well as the health and environmental policies of the organization,
- the system is based primarily on prevention rather than correction after an incident, and
- the system is flexible and capable of simple modification and evolutionary change.

There is no "right" or "wrong" way for an individual company to develop management systems or to meet the intent of this Code of Practice. Approaches and management system details will vary from one company to another depending on local circumstances, the type of operations being carried out, specific product lines, geography and climate.

There are however certain characteristics of any management system that should be in place to ensure that the program is carried out efficiently and effectively. The following characteristics are sufficiently generic so as to apply to systems for managing virtually any technical activity.

Planning	Explicit Goals and Objectives
	Well-Defined Scope
	Clear-Cut Desired Outputs
	Consideration of Alternate Achievement Mechanisms
	Well-Defined Inputs and Resource Requirements
	Identification of Needed Tools and Training
Organization	Strong Sponsorship
	Clear Lines of Authority
	Variance Procedures
	Audit Mechanisms
	Corrective Action Mechanisms
	Procedure Renewal and Reauthorization
	Explicit Assignment of Roles and Responsibilities
	Formal Procedures
Implementation	Internal Coordination and Communication
	Detailed Work Plans
	Specific Milestones for Accomplishments
	Initiating Mechanisms
Control	Performance Standards and Measurement Methods
	Checks and Balances
	Performance Measurement and Reporting
	Internal Reviews

This list is not necessarily definitive. Not all features or characteristics may be needed in every specific situation. Exceptions and departures based on local circumstances are acceptable. Suggested changes and additions based on actual experience are to be encouraged.

Additional information on these characteristics can be found in Appendix E.

ENVIRONMENTAL CODE OF PRACTICE FOR DEGREASING FACILITIES

PART I

Applicability

- 1 1 This Code of Practice applies to all persons who own or operate batch-loaded or conveyonized cold cleaners, open-top or conveyonized vapour degreasers or remote reservoir cold cleaners (parts washers) and who carry out solvent cleaning operations with a solvent containing volatile organic compounds (VOCs), except as noted in Subsection 1 2
- 1 2 The provisions of this Code of Practice do not apply to cleaning solvents that have a VOC content of two percent or less by volume, as used in the degreaser¹
- 1 3 The provisions of Paragraph 5 2 11 of this Code of Practice do not apply if emulsion cleaners are used, provided the cleaned parts are immediately rinsed with water
- 1 4 Subject to Subsection 15 3, the provisions of Sections 3 through 13 of this Code of Practice do not apply if the three-year rolling average of solvent consumption is less than 1000 litres per year
- 1 5 Sections 2, 3, 4, 5, 6 and 7 apply to all types of degreasing operations

PART II Design, Equipment and Operating Standards for Existing and New Degreasing Facilities

Any person owning or operating a solvent cleaning (degreasing) facility should

Assessment of Need and Cleaning Alternatives

- 2 1 Assess the need to use degreasing technology for various operations of the facility in order to meet applicable product standards
- 2 2 Assess the degree of cleaning that is required for the various operations of the facility to meet applicable product standards

¹ This determination should be based on the test method identified in PART III of this Code. Operators may wish to check with their suppliers to verify actual solvent VOC content

- 2 3 Assess the technical and economic feasibility of using non-organic solvent degreasing systems in the various operations of the facility
- 2 4 Assess the technical and economic feasibility of using low-volatility solvents in the facility

Management Systems and Operating Procedures

- 3 1 Develop and implement management systems, appropriate to each unique operation, that integrate health, safety and environmental considerations into each aspect of the operation, from the design and manufacture of a degreaser, through to its use, as well as the recycling and disposal of solvents and solvent-containing wastes. Detailed information on the characteristics of a management system are included in Appendix E
- 3 2 Develop, and place in an accessible and conspicuous location near the degreaser, written operating procedures and requirements that encompass the requirements of this Code and cover all aspects of the facility's operations, including normal operations, start up, shut down, solvent conservation, solvent segregation, solvent filtration, solvent reclamation, routine maintenance, cleaning and maintenance of degreaser equipment, containment and recovery of spills, acid degreaser treatment and solvent-containing waste disposal. Refer to Appendix C for recommended operating procedures and standards

Basic Equipment Standards

- 4 1 In addition to the applicable provisions of Sections 8 through 13, provide the degreaser with at least a down-time cover
- 4 2 For new degreasers, ensure that
 - 4 2 1 The piping, valves and fittings are welded or flanged using fluorinated elastomer gaskets or other gasket material that is compatible with the solvent being used
 - 4 2 2 Except for ball valves, valves have retained or captive spindles and permit on-line tightening or replacement of gland packing or diaphragms should a leak be detected
 - 4 2 3 Pumps are equipped with double mechanical seals
- 4 3 For existing degreasers, substitute whenever the opportunity exists
 - 4 3 1 Welded or flanged piping, using fluorinated elastomer gaskets or other gasket material that is compatible with the solvent being used, for threaded joints. If threaded fittings are retained, standard pipe dopes must be avoided and replaced with fluorinated elastomer tapes, graphite or glycerine pastes
 - 4 3 2 Low emission valves, pumps and, where applicable, efficient water separators as described in Paragraphs 4 2 2, 4 2 3, 9 1 9 and 12 1 4 for existing equipment

Basic Operating Standards

- 5 1 Monitor actual performance on a regular basis to ensure that the operating procedures referred to in Subsection 3 2 are being met
- 5 2 In addition to the applicable provisions of Sections 8 through 13, meet or exceed the following requirements
 - 5 2 1 For cold cleaners, adjust the solvent levels in the degreaser as required to maintain the freeboard ratio requirements of this Code as defined in Tables 1 and 3
 - 5 2 2 Limit the average draft rate at the degreaser, as measured parallel to the plane of the degreaser opening, to 9 1 metres per minute (30 feet per minute), unless a higher rate is specifically required to meet occupational health and safety requirements
 - 5 2 3 Limit the air ventilation rate in a hood, enclosure or from a lip exhaust to 20 cubic metres per minute per square metre (720 cubic feet per minute per square foot) of air-vapour or air-solvent interface surface area, unless
 - (1) an automated bi-parting cover is provided which isolates the degreaser from the air being exhausted, or
 - (2) a higher rate is specifically required to meet occupational health and safety requirements
 - 5 2 4 Avoid positioning ventilation fans in a way that directs air flow toward degreasing units
 - 5 2 5 Carry out solvent agitation, if necessary, by the following methods only the movement of parts through a static solvent, pump recirculation, ultra-sonics, or a mixer The degreaser cover must remain closed while this process is in operation
 - 5 2 6 Ensure that the workload area is centred and does not exceed 50 percent of the air-solvent interface surface area or the air-vapour interface surface area, as appropriate
 - 5 2 7 Rack parts to be cleaned in a manner that allows complete drainage to avoid drag-out
 - 5 2 8 For degreasers equipped with lip exhausts
 - (1) shut off the exhaust fan whenever the degreaser is covered unless specifically required to meet occupational health and safety requirements, or
 - (2) provide an automated bi-parting cover below the lip exhaust inlet level

- 5 2 9 Subject to the specific dwell requirements set out in Tables 1 through 4 drain parts immediately after cleaning until one of the following conditions exists
- (1) a dwell period of at least 15 seconds has elapsed,
 - (2) dripping of solvent ceases, or
 - (3) the parts become visibly dry
- 5 2 10 Inspect the degreaser and associated piping daily for leaks and immediately replace any defective parts
- 5 2 11 Avoid the degreasing of porous or absorbent material such as cloth, leather, wood or rope

Solvent Storage and Handling Standards

- 6 1 Equip bulk solvent storage tanks with a capacity of greater than 1000 litres with
- 6 1 1 pressure-vacuum conservation vents that reduce vapour losses due to tank "breathing" caused by temperature changes,
 - 6 1 2 an air dryer, located in the breather vent line to prevent entry of moisture into the tank, if halogenated solvents are used,
 - 6 1 3 a permanent submerged fill pipe, and
 - 6 1 4 dikes and a drain containment system with sufficient capacity to contain spills or leaks before they evaporate
- 6 2 To minimize solvent loss
- 6 2 1 Transfer solvent from tank cars, trucks or drums to storage tanks through an outlet that is submerged below the liquid level of the solvent in the receiving tank
 - 6 2 2 Transfer solvent from drums through a submerged discharge line to storage tanks and/or degreasers by means of a pump connected to the bung opening of the drum
 - 6 2 3 Completely drain transfer hoses or pipes into a closed vessel immediately after the transfer and cap the hoses with positive locking quick connections of the Kamlok type
- 6 3 Provide separate, closed containers for storing clean and used solvent

Waste Handling and Disposal Standards

7 1 To minimize solvent loss

- 7 1 1 Ensure that waste sludge from a vapour degreaser or solvent still does not contain more than 20 percent volatile organic solvent
- 7 1 2 Store waste sludge in drums that are covered but not tightly sealed until they are removed for disposal

7 2 Unless specific authorization has been received from the relevant authorities to do otherwise, classify degreaser sludge as a hazardous waste and handle and dispose of it in accordance with all applicable federal, provincial and local requirements

Batch-Loaded Cold Degreasers

8 1 In addition to the general requirements set out in Sections 2 through 7, any person owning or operating a batch-loaded cold cleaner, should ensure that

8 1 1 The degreaser

- (1) meets the requirements for batch-loaded cold cleaners as set out in Table 1, or
- (2) incorporates a combination of emission control equipment and operating techniques that can be demonstrated to produce an equivalent reduction in VOC emissions when compared to the requirements set out in Table 1 Refer to Appendix D of this Code for guidance

8 1 2 Solvent flow cleaning, if used, is carried out with a continuous liquid stream, rather than a fine, atomized or shower-type spray, at a pressure that does not exceed 70 kiloPascals (10 psig) Solvent flow should be directed downward to minimize turbulence at the air-solvent interface and to prevent liquid solvent from splashing outside the degreaser

Table 1**Equipment and Operating Standards for New Batch-Loaded Cold Degreasers**

Air-Solvent Interface Surface Area	< 0.5 m ²	0.5 m ² to 1 m ²		1 m ² to 2 m ²		> 2 m ²	
Solvent Volatility ²	Low/High	Low	High	Low	High	Low	High
Cover ³	Manual	Manual	Manual	Manual	Bi-Part	Manual	Bi-Part
Freeboard Ratio ⁴	0.5	0.5	0.75	0.75	1.0	1.0	1.0
Hoist Speed (metres/minute)	-	-	3.3	3.3	1.7 (programmed)	1.7 (programmed)	1.7 (programmed)
Dwell	-	-	-	-	30 sec	15 sec	30 sec

Equipment and Operating Standards for Existing Batch-Loaded Cold Degreasers

Air-Solvent Interface Surface Area	< 0.5 m ²	0.5 m ² to 1 m ²		1 m ² to 2 m ²		> 2 m ²	
Solvent Volatility ⁴	Low/High	Low	High	Low	High	Low	High
Cover ⁵	Dn-Time	Dn-Time	Manual	Manual	Manual	Manual	Bi-Part
Freeboard Ratio ⁶	-	0.5	0.75	0.5	1.0	0.75	1.0
Hoist Speed (metres/minute)	-	-	-	-	3.3	3.3	1.7 (programmed)
Dwell	-	-	-	-	-	-	30 sec

² Refer to the definitions of High-Volatility Solvent and Low-Volatility Solvent in the Glossary

³ Refer to the following definitions in the Glossary: Down-Time Cover (Dn-Time), Manual Cover (Manual) and Bi-Parting Cover (Bi-Part)

⁴ In meeting this requirement the freeboard height should be at least 0.3 metres (1.0 feet) but need not be greater than 1.3 metres (4.0 feet)

Open-Top Vapour Degreasers

- 9 1 In addition to the general requirements set out in Sections 2 through 7, any person owning or operating an open-top vapour degreaser should ensure that
- 9 1 1 The degreaser
- (1) meets the requirements for open-top vapour degreasers as set out in Table 2, or
 - (2) incorporates a combination of emission control equipment and operating techniques that can be demonstrated to produce an equivalent reduction in VOC emissions when compared to the requirements set out in Table 2 Refer to Appendix D of this Code for guidance
- 9 1 2 The load or cleaning rate of the degreaser is maintained at or below the maximum work capacity specified by the manufacturer to prevent vapour level collapse and the resulting vapour loss
- 9 1 3 The capacity to remove heat from the degreaser is at least equal to the heat input to the degreaser
- 9 1 4 The primary condenser water outlet temperature of a degreaser or solvent recovery still is maintained between 32 and 49°C (90-120°F)
- 9 1 5 The solvent temperature in the bath is never allowed to exceed the true boiling point of the solvent by more than 10°C Contact the solvent supplier to determine the causes of high bath temperatures and how to avoid them
- 9 1 6 The following safety switches, or their equivalent, each with a manual reset feature, are installed and operating on the degreaser
- (1) a vapour level control switch designed to control the solvent vapour level at the midpoint of the primary condenser coils,
 - (2) a condenser water-flow switch for water-cooled degreasers,
 - (3) a spray pump control switch for solvent flow cleaning that shuts off the spray pump if the normal vapour level drops more than 10 centimetres (4 inches) below the vapour-air interface or if the spraying occurs outside the vapour zone
- 9 1 7 The solvent temperature used for solvent flow cleaning should be maintained close to the vapour temperature to avoid collapsing the vapour layer Solvent flow should be directed downward to minimize turbulence and convection at the air-vapour interface and to prevent liquid solvent from splashing outside the degreaser

Table 2**Equipment and Operating Standards for New Open-Top Vapour Degreasers**

Air-Vapour Interface Surface Area	<0.5 m²	0.5 m² to 1 m²	1 m² to 2 m²	> 2 m²
Solvent Volatility⁵	High	High	High	High
Cover⁶	Manual	Bi-Part	Bi-Part	Bi-Part
Freeboard Ratio⁷	1.0	1.0	1.0	1.0
Hoist Speed (meters/min)	3.3	3.3 (programmed)	1.7 (programmed)	0.9 (programmed)
Dwell	-	minimum 30 sec	minimum 30 sec	minimum 30 sec
Refrig. Freeboard /Refrig. Condenser	-	5°C or less	5°C or less	5°C or less
Sump Thermostat	-	-	-	B.P. + 5°C

Equipment and Operating Standards for Existing Open-Top Vapour Degreasers

Air-Vapour Interface Surface Area	<0.5 m²	0.5 m² to 1 m²	1 m² to 2 m²	> 2 m²
Solvent Volatility⁷	High	High	High	High
Cover⁸	Manual	Manual	Bi-Part	Bi-Part
Freeboard Ratio⁹	1.0	1.0	1.0	1.0
Hoist Speed (metres/min)	-	3.3	3.3 (programmed)	1.7 (programmed)
Dwell	-	-	minimum 30 sec	minimum 30 sec
Refrig. Freeboard/Refrig. Condenser	-	-	5°C or less	5°C or less

⁵ Refer to the definition of High-Volatility Solvent in the Glossary

⁶ Refer to the definitions of Manual Cover (Manual) and Bi-Parting Cover (Bi-Part) in the Glossary

⁷ In meeting this requirement, the freeboard height should be at least 0.3 metres (1.0 feet) but need not be greater than 1.3 metres (4.0 feet)

- 9 1 8 The workload is retained in the vapour zone until condensation ceases
- 9 1 9 Water separators for primary condensers and refrigerated freeboard chillers are covered, have a cooling water inlet temperature of less than 38°C (100°F), a retention time of at least five minutes, and are operated in a manner that minimizes water contamination and avoids "ghosting" . To reduce the water that a solvent will carry, the separation temperature should be as low as practical . All water separators should be equipped with some means of cooling the solvent before or during separation . Ideally, the coolant should be as cold or colder than that used for the condensing coils, i.e. less than 38°C (100°F)
- 9 1 10 A separate condensation trough located below the freeboard refrigeration coils, is provided for degreasers with freeboard chillers, and the condensate is routed to a separate water separator . An equivalent system is acceptable

Conveyorized Degreasers

- 10 1 In addition to the general requirements set out in Sections 2 through 7, any person owning or operating a conveyorized cold or vapour degreaser should ensure that
- 10 1 1 The load or cleaning rate of the degreaser is maintained at or below the maximum work capacity specified by the manufacturer to minimize solvent loss
- 10 1 2 Drag-out losses are minimized by means of equipment or techniques such as drying tunnels or rotating baskets
- 10 1 3 The entrances and exits silhouette workloads, with an average clearance between the parts and the edge of the degreaser opening of less than 10 cm (4 inches), or less than 10 percent of the width of the opening
- 10 1 4 Down-time covers are provided and used to close off the entrance and exit of the degreaser during shut-down hours or when it is not in use
- 10 2 In addition to the requirements set out in this Section, new conveyorized degreasers should utilize U-bend designs or employ internal baffles to reduce solvent losses resulting from air flowing through the degreaser

Conveyorized Cold Degreasers

- 11 1 In addition to the requirements set out in Sections 2 through 7 and 10, any person owning or operating a conveyorized cold degreaser should ensure that the degreaser
- 11 1 1 Meets the requirements for cold conveyorized degreasers as set out in Table 3, or

11 1 2 Incorporates a combination of emission control equipment and operating techniques that can be demonstrated to produce an equivalent reduction in VOC emissions when compared to the requirements set out in Table 3 Refer to Appendix D of this Code for guidance

11 2 Solvent flow cleaning, if used, should be directed downward to minimize turbulence at the air-solvent or air-vapour interface

Conveyorized Vapour Degreasers

12 1 In addition to the requirements set out in Sections 2 through 7 and 10, any person owning or operating a conveyorized vapour degreaser should ensure that

12 1 1 The degreaser

(1) meets the requirements for conveyorized vapour degreasers as set out in Table 4, or

(2) incorporates a combination of emission control equipment and operating techniques that can be demonstrated to produce an equivalent reduction in VOC emissions when compared to the requirements set out in Table 4 Refer to Appendix D of this Code for guidance

12 1 2 The capacity to remove heat from the degreaser is at least equal to the design heat input capacity

12 1 3 Primary condenser water outlet temperature of a degreaser or solvent recovery still is maintained between 32 and 49°C (90-120°F)

12 1 4 The solvent temperature in the bath is never allowed to exceed the true boiling point of the solvent by more than 10°C Contact the solvent supplier to determine the causes of high bath temperatures and how to avoid them

12 1 5 The solvent temperature used for solvent flow cleaning should be maintained close to the vapour temperature to avoid collapsing the vapour layer Solvent flow should be directed downward to minimize turbulence and convection at the air-vapour interface and to prevent liquid solvent from splashing outside the degreaser

Table 3

Equipment and Operating Standards for New Conveyorized Cold Degreasers

Air-Vapour Interface Surface Area	<0.5 m ²	0.5 m ² to 1 m ²		1 m ² to 2 m ²		> 2 m ²	
Solvent Volatility ⁹	Low/High	Low	High	Low	High	Low	High
Freeboard Ratio ⁹	0.5	0.5	0.75	0.5	0.75	0.75	1.0
Conveyor Speed (metres/minute)	3.3	3.3	3.3 (programmed)	3.3 (programmed)	1.7 (programmed)	1.7 (programmed)	1.7 (programmed)

Equipment and Operating Standards for Existing Conveyorized Cold Degreasers

Air-Vapour Interface Surface Area	<0.5 m ²	0.5 m ² to 1 m ²		1 m ² to 2 m ²		> 2 m ²	
Solvent Volatility ¹⁰	Low/High	Low	High	Low	High	Low	High
Freeboard Ratio ¹¹	0.5	0.5	0.75	0.5	0.75	0.5	0.75
Conveyor Speed (metres/minute)	-	-	3.3	3.3	3.3 (programmed)	3.3 (programmed)	1.7 (programmed)

⁹ Refer to the definitions of High-Volatility Solvent and Low-Volatility Solvent in the Glossary

⁹ In meeting this requirement, the freeboard height should be at least 0.3 metres (1.0 feet) but need not be greater than 1.3 metres (4.0 feet)

12 1 6 The following safety switches, or their equivalent, each with a manual reset feature, are installed and operating on the degreaser

- (1) a vapour level control switch designed to control the solvent vapour level at the midpoint of the primary condenser coils,
- (2) a condenser water flow switch for water-cooled degreasers,
- (3) a spray pump control switch for solvent flow cleaning that shuts off the spray pump if the normal vapour level drops more than 10 cm (4 inches) below the vapour-air interface or if the spraying occurs outside the vapour zone

12 1 7 Water separators for primary condensers and refrigerated freeboard chillers are covered, have a cooling water inlet temperature of less than 38°C (100°F), a retention time of at least five minutes, and are operated in a manner that minimizes water contamination and avoids "ghosting" To reduce the water that a solvent will carry, the separation temperature should be as low as practical All water separators should be equipped with some means of cooling the solvent before or during separation Ideally, the coolant should be as cold or colder than that used for the condensing coils, i.e. less than 38°C (100°F)

12 1 8 A separate condensation trough, located below the freeboard refrigeration coils is provided for degreasers with freeboard chillers, and the condensate is routed to a separate water separator An equivalent system is acceptable

Remote Reservoir Cold Cleaners (Parts Washers)

13 1 In addition to the applicable general requirements set out in Sections 2 through 7, any person owning or operating a remote reservoir cold cleaner (parts washer) should ensure that

13 1 1 Solvent vapours are prevented from escaping from the solvent container by means of a closing cover or device such as a valve, when the remote reservoir is not being used, cleaned or repaired, and

13 1 2 Flow solvent cleaning, if used, is carried out with a continuous liquid stream, rather than a fine, atomized or shower type spray, at a pressure that does not exceed 70 kiloPascals (10 psig) Solvent flow should be directed downward to minimize turbulence at the air-solvent interface and to prevent liquid solvent from splashing outside the degreaser

Table 4**Equipment and Operating Standards for New Conveyorized Vapour Degreasers**

Air-Vapour Interface Surface Area	< 0.5 m ²	0.5 m ² to 1 m ²	1 m ² to 2 m ²	> 2 m ²
Solvent Volatility ¹⁰	High	High	High	High
Freeboard Ratio ¹¹	1.0	1.0	1.0	1.0
Conveyor Speed (metres/minute)	3.3	3.3 (programmed)	1.7 (programmed)	1.7 (programmed)
Superheated Vapour	-	Yes	Yes	Yes
Dwell	-	minimum 30 sec	minimum 30 sec	minimum 30 sec
Refrig Freeboard	-	5°C or less	5°C or less	-20°C or less
Sump Cooling	-	Yes	Yes	Yes
Sump Thermostat	-	-	B P + 5°C	B P + 5°C

Equipment and Operating Standards for Existing Conveyorized Vapour Degreasers

Air-Vapour Interface Surface Area	< 0.5 m ²	0.5 m ² to 1 m ²	1 m ² to 2 m ²	> 2 m ²
Solvent Volatility ¹²	High	High	High	High
Freeboard Ratio ¹³	1.0	1.0	1.0	1.0
Conveyor Speed (metres/minute)	-	3.3	3.3 (programmed)	1.7 (programmed)
Superheated Vapour/Hot Vapour Recycle	-	-	Yes	Yes
Dwell	-	-	minimum 30 sec	minimum 30 sec
Refrig Freeboard /Refrig Condenser	-	-	5°C or less	5°C or less
Sump Cooling	-	-	Yes	Yes

¹⁰ Refer to the definition of High-Volatility Solvent in the Glossary

¹¹ In meeting this requirement the freeboard height should be at least 0.3 metres (1.0 feet) but need not be greater than 1.3 metres (4.0 feet)

Wipe Cleaning

- 14 1 In addition to the applicable general requirements set out in Sections 2 through 7, any person employing the wipe cleaning technique, and whose annual solvent use is 1000 litres or more, should
 - 14 1 1 Use the minimum amount of solvent required
 - 14 1 2 Minimize the size of the wipe cloth used
 - 14 1 3 Use a closed solvent-dispensing container, such as the plunger-type can or the so-called safety can with a spring-loaded cover on the pouring spout
 - 14 1 4 Immediately after use, wring out or centrifuge dirty cloths and rags to recover as much solvent as possible and then, without delay, store contaminated rags, glove liners and clothes in closed containers prior to laundering or disposal
 - 14 1 5 Employ techniques that minimize VOC emissions during laundering or disposal

PART III

Record Keeping

- 15 1 Subject to Subsection 15 3, any person owning or operating a solvent degreaser should retain the following records for a period of three years in a form that will permit review by relevant environmental authorities
 - 15 1 1 Records, including quantities and dates, of all solvent used solvent, waste solvent and sludge (including estimated solvent content) entering or leaving the premises or transferred from one vessel to another on the site
 - 15 1 2 Dates and quantities of solvent reclamation operations that are carried out, including the disposition and estimated solvent content of the sludges
 - 15 1 3 Records of all cleaning and maintenance that is carried out, including the operations that are performed and the disposition of any waste material generated
 - 15 1 4 Records of treatment of acid degreaser situations
 - 15 1 5 Records covering the disposal of used solvents, sludges, used rags and contaminated clothing that results from degreasing operations

- 15 2 Subject to Subsection 15 3, any person owning or operating a solvent degreaser should retain, for a period of three months, in a form that will permit review by relevant environmental authorities, the daily self-inspection checklists covering the items outlined in the sections of Appendix C of this Code entitled "Normal Operations" and "Routine Maintenance"
- 15 3 If the three-year rolling average of solvent consumption for a solvent degreasing operation is less than 1000 litres per year, only the dates, quantities and types of solvent purchased need be retained

Test Methods

- 16 1 The following test methods, or their equivalent, should be used for the purposes of this Code of Practice
- (1) The VOC content of sludges should be determined by the EPA reference method 24 (Determination of Volatile Matter Content, Water Content Density Volume Solids and Weight Solids of Surface Coating, Code of Federal Regulations Title 40, Part 60, Appendix A) The VOC content of cleaning solvents should be determined by South Coast Air Quality Management District (SCAQMD) Laboratory Methods of Analysis for Enforcement Samples - Section III, Method 22
 - (2) The initial boiling point of solvents should be determined by ASTM Method D-1078-78, "Standard Test Method for Distillation Range of Volatile Organic Liquids "
 - (3) Measurements of ventilation rates in a hood or enclosure should be done according to EPA Test Method 2, 2A, 2C, or 2D SCAQMD Method 1 1 should be used to measure the number of traverse points
 - (4) Measurement of average workroom draft rate should be done parallel to the plane of the degreaser opening with a thermistor anemometer with an accuracy of within plus or minus two feet per minute and a calibration traceable to The National Institute of Standards and Technology

PART IV

Training

- 17 1 Before operating solvent degreasers and associated equipment, operating personnel should receive training and instructions covering occupational health and environmental aspects, commensurate with their responsibilities
- The theory, characteristics and value of management systems

- Applicable health, safety and environmental laws and regulations including those governing labelling (WHMIS), spills, emergencies and reporting, solvent and waste handling and waste disposal
- All applicable aspects of this Code of Practice including
 - equipment and operating standards
 - solvent storage and handling
 - waste handling and disposal
 - record keeping
 - test methods
- All applicable operating procedures and standards including
 - normal operations including daily check lists
 - routine maintenance
 - solvent conservation and maintenance
 - cleaning and maintaining degreasing equipment including safety procedures and entry requirements
 - containment and recovery of spills
 - handling and disposal of wastes
 - vapour degreaser start up, shut down and treatment of an acid degreaser
- Test methods and procedures
- Applicable occupational exposure limits and the use of personal protective and monitoring equipment
- Benefits of following this Code of Practice

Additional sources of information for this purpose include

- provincial and federal environmental regulatory agencies
- provincial occupational health and safety agencies
- solvent suppliers
- equipment suppliers and their associations, e g , ASTM
- information contained in the Appendices of this Code of Practice
- the bibliography contained in the Reference Document to this Code *VOC Emissions from Solvent Degreasing*

Appendix A

List of Commercial/Industrial Degreasing Task Force Members

Task Force Members

K K Bhattacharyya	Greater Vancouver Regional District
Daniel Bidal	Pacific & Yukon Region, Environment Canada
Pauline Brown	Ontario Region, Environment Canada
Fred Chen	Industrial Sectors Branch, Environment Canada (Chairperson)
Jack Dupuis	Canadian Association of Metal Finishers
David Flahaut	Safety-Kleen Canada Inc
Marshall Kern	Dow Chemical Canada Inc
Suresh Khandelwal	Industry Canada
Luc Lefebvre	Communauté urbaine de Montreal
Peter Miasek	Imperial Oil Chemical Division
Leroy O'Brien	Du Pont Canada Inc
John Prinsen	Industrial Sectors Branch, Environment Canada
Nicole Riberdy	Environmental Choice Program, Environment Canada
Murray Smith	Union Gas Limited
Marjorie Tepina	Ontario Ministry of the Environment and Energy
Bruce Walker	STOP

Corresponding Members

John Baguzis	Ford Motor Co
J-F Banville	Quebec Region, Environment Canada
Mark Cotter	Automotive Parts Manufacturers' Association
Jerry Ertel	Shell Canada Ltd
Howard Goodfellow	Goodfellow Consultants Inc
Neil Groves	Westinghouse Canada Inc
Kurt Hansen	Western Research
Hugh Harris	Hugh G & Associates Inc
Joel Hartlet	Ivaco Rolling Mills
John Jonasson	Manitoba Ministry of the Environment
Jim Knight	New Brunswick Ministry of the Environment
Patricia Land	Land Environment Ltd
Serge Langdeau	Commercial Chemicals Branch Environment Canada
Chow-Seng Liu	Alberta Ministry of the Environment
Lori MacLean	Environmental Dimension
Vena Marwaha	Prairies & Northwest Region, Environment Canada
Ann McKinnon	Atlantic Region, Environment Canada
Claude Messier	CP Rail
Heny Micheal	Dames & Moore, Canada
Scott Munro	Lambton Industrial Society
Yasmin Tarmohamed	Ontario Region, Environment Canada
Roger Taylor	Baycoat
J B Thorsteinsson	Public Works and Government Services Canada
Marc Tremblay	Biothermica International Inc
Christopher Webb	Enviro-Man Services Inc
Jia Zhang	B C Ministry of the Environment
Dirk Zinkweg	Dow Chemical Canada Inc

Appendix B

Self-Assessment Questionnaire

Company

Division

Location

Manager responsible for product movement _____

Assessed by _____ Date _____

Reviewed by _____ Date _____

Approved by C E O _____ Date _____

Next assessment due _____ Date _____

CRITERIA TO ASSESS IMPLEMENTATION OF CODE OF PRACTICE

Completed
Work in progress
Work not started

GENERAL

1 1	A coordinator has been designated by senior management to implement this Code of Practice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 2	The coordinator has been trained and is knowledgeable in all aspects of this Code and its ramifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 3	The coordinator has reviewed program requirements with senior management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 4	A policy that covers compliance with this Code has been developed and communicated to all appropriate employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 5	The information in this Code and the Compliance Program has been communicated to all contract resources that provide degreaser related services to the company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 6	Clearly defined responsibilities for generating, implementing, auditing and updating applicable items of this Code, such as noted below, have been defined in writing and communicated to those responsible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 6 1	Policies regarding degreasing operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 6 2	Equipment and operating standards for degreasing operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1 6 3	Procedures regarding the operation of degreasers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 0	Assessments have been carried out with respect to			
2 1	The need to use degreasing technology to meet applicable product standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 2	The degree of cleaning required to meet applicable product standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 3	The technical and economic feasibility of using non-organic solvent degreasing systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 4	The technical and economic feasibility of using low-volatility solvents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note

The following aspects may not all apply to all degreasing operations. If a situation does not apply to you, indicate this by marking N/A in one of the boxes provided.

3 1	Written operating procedures and requirements have been developed and placed in a conspicuous location near the degreaser for the following situations	Completed	Work in progress	Work not started
3 1 1	Normal operation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 2	Degreaser start up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 3	Degreaser shut down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 4	Solvent conservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 5	Solvent segregation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 6	Solvent filtration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 7	Solvent reclamation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 8	Routine maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 9	Cleaning and maintenance of degreasing equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 10	Containment and recovery of spills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 11	Acid degreaser treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 12	Solvent waste disposal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 1 13	Test methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 2	The company has current copies of, or has access to, all applicable laws and regulations that pertain to the company's degreasing operations or can demonstrate awareness of such regulations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 3	The company has clearly defined and documented responsibilities for responding to changes in laws and regulations which pertain to the company's degreasing operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- | | | | |
|---|--------------------------|--------------------------|--------------------------|
| 3 4 The management systems referred to in Subsection 3 1 of the Code have been developed and implemented | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 5 The management systems referred to in Subsection 3 1 of the Code are being regularly monitored to ensure they are being met | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Note

The following aspects all relate to reducing high solvent consumption (and atmospheric emissions) Compliance with the Code will reduce solvent costs, improve product quality and consistency and improve workplace conditions Not all aspects apply to all degreasing activities however Select only those aspects that apply to your facility and workplace and indicate the degree to which corrective action has been taken If an activity does not apply to you, indicate this by marking N/A in one of the boxes provided

BASIC EQUIPMENT REQUIREMENTS

- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| 4 0 The degreasing facility meets or exceeds the requirements set out in Section 4 of the Code for the following aspects | | | |
| 4 1 Degreaser covers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 2 Welded or flanged piping, valves and fittings with compatible gasket material | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 3 Valves that permit on-line tightening to eliminate leaks | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 4 Pumps with double mechanical seals | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

BASIC OPERATING STANDARDS

	Completed	Work in progress	Work not started
5 0 The degreasing facility meets or exceeds the requirements set out in Section 5 of the Code for the following aspects			
5 1 Solvent levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 2 Average draft rates are less than 9 1 meters per minute	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 3 Air ventilation rates in hoods, enclosures and from lip exhausts are less than 20 cubic meters per minute per square meter of air-solvent or air-vapour interface area unless a bi-parting cover is provided or special authorization is received	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 4 Ventilation fans do not direct air flow towards degreasing units	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 5 Solvent agitation is carried out only by the movement of parts through a static solvent, pump recirculation, ultra-sonics, or a mixer and the degreaser cover is kept closed during agitation operation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 6 Workload area is centred and does not exceed 50 percent of air-solvent or air-vapour interface area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 7 Parts are racked in a manner that allows complete drainage and avoids dragout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 8 For degreasers equipped with lip exhausts, the exhaust fan is shut off when the degreaser is covered or an automated bi-parting cover is provided below the lip exhaust	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 9 Parts are drained until 15 seconds have elapsed, dripping of solvent ceases or parts are visibly dry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 10 The degreaser and its piping is inspected daily for leaks, if found immediate action is taken to repair them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 11 The degreasing of porous or absorbent material is not permitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SOLVENT STORAGE AND HANDLING STANDARDS

- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| 6 1 Bulk storage tanks with over 1000 litres capacity are diked, have conservation vents, air intake driers and permanent submerged fill pipes
If halogenated solvents are used, they are equipped with air intake driers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6 2 Transfer of solvent is done through a submerged discharge line in the receiving tanks Transfer of solvent from drums is done with a pump connected to the bung opening | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6 3 Transfer lines and hoses are routinely drained to a closed vessel and equipped with positive quick locking connections | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6 4 Separate closed containers are provided for storing clean and used solvent | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

WASTE HANDLING AND DISPOSAL

- | | | | |
|---|--------------------------|--------------------------|--------------------------|
| 7 1 Waste sludge contains less than 20 percent volatile organic solvent | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7 2 Waste sludge is stored in covered (not sealed) drums prior to disposal | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7 3 Degreaser sludges are classified as hazardous wastes and handled and disposed of in accordance with all applicable laws and regulations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

BATCH-LOADED COLD CLEANERS

- | | | | |
|---|--------------------------|--------------------------|--------------------------|
| 8 1 The degreasing facility meets or exceeds the requirements set out in Table 1 of the code, or equivalent for the following aspects | | | |
| 8 1 1 Degreaser covers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 1 2 Freeboard ratio | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 1 3 Hoist speed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 1 4 Dwell | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 2 The degreasing facility meets or exceeds the requirements set out in Subsection 8 1 2 of the Code with respect to solvent flow cleaning | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

OPEN-TOP VAPOUR DEGREASERS

9 1 The degreasing facility meets or exceeds the requirements set out in Table 2 of the Code, or equivalent, for the following aspects

	Completed	Work in progress	Work not started
9 1 1 Degreaser covers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 1 2 Freeboard ratio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 1 3 Hoist speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 1 4 Dwell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 1 5 Refrigerated freeboard or refrigerated condensers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 1 6 Sump thermostat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9 2 The degreasing facility meets or exceeds the requirements set out in Section 9 of the Code for the following aspects

9 2 1 Workload or cleaning rate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 2 Heat removal capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 3 Primary condenser water is maintained between 32-49°C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 4 Bath temperature does not exceed the true boiling point of the solvent by more than 10°C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 5 Safety switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 6 Manual reset feature on all safety switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 7 Solvent flow cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 8 Retaining workload in vapour zone until condensation ceases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 9 Water separators are covered, have a retention time of at least five minutes, there is no chronic "ghosting" and they are provided with external cooling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 2 10 A separate condensation trough and water separator is provided for degreasers with freeboard chillers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CONVEYORIZED DEGREASERS

	Completed	Work in progress	Work not started
10 1 The degreasing facility meets or exceeds the requirements set out in Section 10 of the Code for the following aspects			
10 1 1 Workload or cleaning rate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 1 2 Heat removal capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 1 3 Silhouetting entrances and exits to workload profiles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 1 4 Application of down-time covers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CONVEYORIZED COLD DEGREASERS

11 1 The degreasing facility meets or exceeds the requirements set out in Table 3 and Section 11 of the Code for the following aspects			
11 1 1 Freeboard ratio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 1 2 Conveyor speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 1 3 Solvent flow cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CONVEYORIZED VAPOUR DEGREASERS

12 1 The degreasing facility meets or exceeds the requirements set out in Table 4 and Section 12 of the Code for the following aspects			
12 1 1 Freeboard ratio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 2 Conveyor speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 3 Superheated vapour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 4 Dwell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 5 Refrigerated freeboard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 6 Sump cooling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 1 7 Sump thermostat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Completed	Work in progress	Work not started
12 2 The degreasing facility meets or exceeds the requirements set out in Section 12 of the Code for the following aspects			
12 2 1 Heat removal capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 2 Primary condenser water is maintained at 32-49°C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 3 Bath temperature does not exceed the true boiling point of the solvent by more than 10°C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 4 Solvent flow cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 5 Safety switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 6 Manual reset feature on all safety switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 7 Water separators are covered, have a retention time of at least five minutes, there is no chronic "ghosting" and they are provided with external cooling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 2 8 A separate condensation trough and water separator is provided for degreasers with freeboard chillers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

REMOTE RESERVOIR COLD CLEANERS

13 1 The degreasing facility meets or exceeds the requirements set out in Section 13 of the Code for the following aspects			
13 1 1 Escape of solvent vapours from solvent container	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13 1 2 Solvent flow cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

WIPE CLEANING

14 1 Practices meet or exceed the requirements set out in Section 14 of the Code for the following aspects			
14 1 1 Minimizing solvent use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14 1 2 Minimizing the size of the wipe cloth used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Completed	Work in progress	Work not started
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14 1 3	Use of a closed solvent dispensing container	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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14 1 4	Storage of contaminated rags, clothing etc prior to laundering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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14 1 5	Laundering techniques of contaminated articles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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RECORD KEEPING

15 1	Practices meet or exceed the requirements set out in Section 15 of the Code	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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TRAINING

16 1	A training program consistent with this Code has been developed and implemented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Action Plan:

Appendix C

Typical Operating Procedures and Standards

Normal Operation

The importance of "good housekeeping" cannot be stressed too strongly. Cleanliness is essential for the safety of the operator, the economy of the operation and the effectiveness of the process. The following practices should be routinely followed:

1. Inspect equipment daily to ensure that the operating standards contained in this code are being met. This includes verifying the hoist speed, ensuring the freeboard ratio is being met, and that all containers containing solvent are covered.
2. Inspect parts to ensure that they are visually dry when they leave the degreaser. If this is not the case, adjust the racking of parts to allow drainage. Never use forced air to dry cleaned parts.
3. Never dispose of used solvent down a sewer or put it in a drum containing used oil.
4. Regularly check the solvent contamination level and never let it exceed 25 percent. Contact the solvent supplier for help determining solvent contamination levels for a number of specific chlorinated solvents.

Excessive solvent contamination will lead to solvent breakdown, insufficient vapour generation, sludge formation and the baking of sludge on the tank bottom and heating elements. In addition, ensure that the maximum recommended sump temperature for the solvent being used is not exceeded. The boiling temperature of oil-solvent mixtures can rise to a level that reduces cleaning effectiveness and increases emissions.

5. Monitor the solvent condition for acid acceptance on a routine basis according to the solvent supplier's recommendations and depending on the type of solvent and the type of work being carried out. Acid acceptance test kits are available from solvent suppliers.

Routine Maintenance

Some recommended procedures follow. Most of these should be performed daily. Temperatures, liquid flows and steam pressures (where used) should be checked even more frequently.

1. Ensure that all compartments of the equipment are maintained at proper operating levels.

- 2 When starting the equipment each day, observe whether excessive time is required for the vapour level to rise and hold steady at the midpoint of the condenser coils. Also observe whether the vapour level drops abnormally when work is put through. If either of these conditions occurs, the unit may require cleaning, whether normally recommended cleanout temperatures have been reached or not.
- 3 Clean liquid level sight glasses and porthole glasses.
- 4 Check solvent pumps, gasketed closures, transfer lines and other connections for leaks daily. Repair leaks as soon as possible to reduce solvent loss and increase safety. If steam is used for heat input, check steam pressure and steam trap operation.
- 5 Check sump temperature to determine contamination level.
- 6 Frequently check the temperature of condenser coolant discharge.
- 7 If the water drain outlet on the water separator is valved, open the valve frequently to allow accumulated water to drain out.
- 8 Periodically check solvent flow returning to the degreaser from the water separator. Diminished solvent flow may indicate the following:
 - (a) partial blockage of the distillate line from collecting trough,
 - (b) reduced rate of vapour generated due to sludging of heating elements
 - (c) excessive contamination, or
 - (d) reduced heat input
- 9 Inspect the condensate collecting trough frequently. If the trough is overflowing a block may have developed in the distillate line between the condensate trough outlet and the water separator.
- 10 Since solvent vapours remove lubricant from conveyor systems, lubricate them frequently.

Solvent Conservation

The effectiveness of a degreasing operation is dependent on the ability of the facility to produce a constant supply of clean solvent vapour for cleaning. To accomplish this, the contamination level in the solvent should be kept as low as possible.

The regular distillation of contaminated solvent that occurs in the vapour degreasing process produces quantities of waste oils, greases and other contaminants that require proper disposal. If solvent recovery is not practised, these wastes can account for as much as 30 percent of total solvent losses. The percentage can be higher in cold cleaning operations in which distillation is frequently not part of the cleaning process.

Solvent Segregation

Solvent losses can be reduced by avoiding mixture of used solvents. Recovery is much easier if the spent solvents are kept separate from the outset.

Solvent Filtration

Some vapour degreasers are equipped with a filtration system to remove particulate matter from the solvent. Filters should be allowed to dry thoroughly before removal or replacement to reduce solvent loss. Used filter cartridges should be kept in closed containers pending proper disposal.

Solvent Reclamation

Solvent reclamation is one of the most common methods for degreaser operators to handle waste solvents and reduce costs.

Internal Distillation

In some operations, reclamation of the solvent involves distilling the solvent within a vapour degreaser's boiling sump and diverting the distillate to a separate tank or drum. This internal solvent recovery has several limitations:

- (a) The degreaser must be taken out of service for a number of hours.
- (b) The bottoms, after concentration, often contain more than 50 percent solvent. This material is a high-volume hazardous waste that usually requires additional pre-treatment and high disposal costs.
- (c) The practice generally increases emissions to the atmosphere.

The high level of solvent remaining in the sludge can generally be expected to exceed the requirements of this Code and would necessitate hiring a commercial recycler to dispose of the waste.

External Distillation

Stills specifically designed for solvent recovery are more efficient than internal distillation. The still may operate on a continuous basis or the contaminated solvent may be collected regularly and reclaimed in a batch process.

Continuous distillation allows constant clean-up of the solvent and does not require that the degreaser be shut down as often. It will, however, be necessary to shut off the solvent supply periodically to concentrate and dispose of the contaminants in the still. In batch operations, direct connection of the still to the degreaser will avoid the need for manual transfer of solvent and thereby reduce emission losses.

An external still offers a higher rate of solvent recovery than is possible with distillation in the degreaser itself. It is possible to concentrate the contaminants so that less than 10 percent solvent remains in the sludge. In addition, stills may be equipped with steam injection to recover all but the very last traces of the remaining solvent.

Most distillation units used in recovery operations are atmospheric stills. Single plate stills are commercially available in capacities ranging from 2 to 50 litres per hour. The smaller systems are self-contained, off-the-shelf units.

Because of their large vapour-air interface, however, atmospheric units can have significant solvent losses. Several newer designs employ a vacuum that reduces the operating pressure to a point at which the solvent starts to evaporate at room temperature. This eliminates the problem of solvent decomposition due to overheating and allows for greater recovery efficiency. This is particularly important for high boiling point solvents, e.g., perchloroethylene.

Operation of an External Still

The basic procedure for startup and operation of an external still is similar to that of a degreaser. The following steps are recommended:

1. Open the valve to supply condensing water.
2. Check settings of control devices, then activate. Thermostatic settings for solvents are available for solvent suppliers.
3. Close drain valve.
4. Fill still with solvent to operating level.
5. Adjust heat input to recommended value for solvent being distilled.
6. Should solvent begin to foam, reduce heat input to prevent contamination of the clean distillate.
7. Check water flow through condenser and the cooling water outlet temperature, which should be maintained between 32-49°C (90-120°F).
8. Concentration of contaminants will raise the boiling point of the solvent. Gradually increase the heat input to the still to maintain a steady rate of distillation.

- 9 When solvent temperature approaches the level of the still's sump thermostat setting, for the particular solvent, distillation will normally end Do not exceed the sump thermostat settings
- 10 Shut off heat supply
- 11 Deactivate control devices
- 12 Cool residue and dispose of sludge in accordance with all applicable environmental laws and regulations

Cleaning and Maintenance of Degreasing Equipment

There is no set rule to govern the frequency of cleaning It will be determined by the volume of work being processed and the nature and quantity of soil that is removed As a guide, degreasers should be boiled down and drained when the contamination level reaches a maximum of 25 percent

The cleaning operation must be carried out by personnel adequately trained in cleanout practice, the toxicology and handling of solvents and the proper use of protective equipment A written procedure with sign-off must be established and adhered to and must cover work-orders detailing all preparatory and cleanout steps to be taken and safety precautions to be followed

External Preparation and Cleaning

With many open-top degreasers, it may be possible to remove dirt, sludge and metal chips from outside the degreaser For larger equipment, the following steps should be taken prior to entering the degreaser

- 1 Turn off heat supply and allow degreaser to cool unless the distillation method is used to remove solvent from the degreaser Keep cooling water flowing
- 2 Remove solvent from degreaser using a pump discharging through a submerged outlet in the receiving vessel A submerged suction pipe drawing from a well in the degreaser will allow the maximum amount of solvent to be recovered Distillation of the solvent from the degreaser is not recommended because of the relatively high solvent losses that result If this procedure is used maintain a minimum of six centimetres (two to three inches) of liquid level above the heating elements to avoid overheating of the elements When completed turn off heat supply and allow degreaser to cool Keep cooling water flowing
- 3 When sump is cool, turn off water supply
- 4 Drain residues
- 5 Ventilate equipment thoroughly to remove residual solvent as completely as possible

- 6 Carefully remove thermometers and safety devices to avoid damage during cleanout
- 7 Disconnect heat supply line fittings
- 8 Disconnect solvent line leading to degreaser and water separator
- 9 Remove cleanout ports and heating elements
- 10 Lock off all power to pumps and conveyors
- 11 Remove dirt, sludge and metal chips from the bottom of each compartment as thoroughly as possible without entering the equipment

Safety Procedures for Entering Degreasers

The following procedures **must** be observed in detail

- 1 The entire system must be drained
 - 2 All access ports must be removed or locked in an open position
 - 3 All solvent vapours must be expelled
 - 4 When out of the explosive range, purge the degreaser with forced air directed toward the bottom of each compartment
 - 5 Using proper instrumentation, measure the air quality inside the degreaser
 - 6 The person entering the degreaser must wear a harness and lifeline and NIOSH/MSHA approved self-contained breathing apparatus of the pressure-demand type with full facemask
 - 7 A second person should hold the free end of the lifeline and must be similarly equipped for degreaser entry and able to communicate at all times with the first person inside the degreaser
 - 8 A third person must be within audible hailing distance The second person **should not** enter the degreaser to remove the first person unless absolutely necessary and **must not enter before the third person has been alerted** The third person **must not** enter the degreaser
-

Internal Cleaning Procedures

- 1 Brush out the condensate trough and check to make certain that there are no obstructions to condensate flow
- 2 Brush cooling coils, walls and compartment floors to remove accumulated rust and scale. Take care to avoid damaging corrosion resistant finishes
- 3 Brush down rusted areas, inspect and lubricate conveyor system or internal drive mechanism as required
- 4 Scrape and brush heating elements free of all caked sludge to ensure efficient heat transfer
- 5 Clean out condensate lines from the collection trough outlet to the water separator and from the water separator to the discharge point in the degreaser
- 6 Clean out the water separator and remove any sludge that may have accumulated in the bottom
- 7 Clean strainers, filters, sight glasses and porthole glasses before reassembly
- 8 Clean and check controls, indicators and regulators before reassembly. Adjust if necessary
- 9 While unit is down, it may be a good time to perform other maintenance including a check of the doors, pipe fittings, gauges, and other trouble spots for leaks. Solvent-resistant gaskets and sealing compounds should be used to help reduce solvent loss
- 10 Reconnect heat input
- 11 If manual cleanout is insufficient, the degreaser may be cleaned with a hot solution of soda ash and water. Fill the unit with water to a level about 10 to 15 centimetres above the heating element and add 500 grams of soda ash per 25 litres of water in the degreaser. Heat this solution for one half hour. The sides and all compartments should be thoroughly washed after which the unit should be drained, rinsed well and dried
- 12 Turn on water supply to condensers and heat exchangers and inspect for water leaks. Repair any leaks
- 13 Fill all compartments to normal levels with solvent and start the degreaser
- 14 Check all solvent lines, valves, fittings, gasketed closures and pumps for leaks and adjust or repair as necessary. Refer to start-up procedure when degreaser is ready for active service

Containment and Recovery of Spills

- 1 Spilled solvent should be cleaned up immediately
- 2 Maximum ventilation should be provided and the area evacuated, except for personnel equipped with proper respiratory and skin/eye protection
- 3 Compressed air or fans should not be used to dry up spills because they will increase air contamination
- 4 Absorb solvent with mops, rags, sawdust or vermiculite and place contaminated material immediately into closed containers for disposal
- 5 Large spills should be diked and evaporation retarded by flooding the contained liquid with water
- 6 DO NOT FLUSH SPILLED SOLVENT INTO PLANT SEWERS OR DRAINS
- 7 Report spill as required by federal, provincial or local regulations
- 8 Wet-vacuum contaminated area after all traces of solvent have been removed

Solvent Waste Disposal

Sludge from vapour degreasers or solvent stills may be stored in drums until ready for disposal. Drums should **not** be tightly sealed especially those containing sludge with aluminum chips or residues.

Solvent-containing sludges should be considered as hazardous waste and handled accordingly. Disposal should be carried out only by approved waste contractors and methods, and all relevant federal, provincial and local laws and regulations should be adhered to.

Before disposing of wastes containing solvents, every effort should be made to recover as much of the solvent as possible by distillation. This will reduce costs as well as emissions. If solvent concentrations in the sludge exceed 20 percent, it will be necessary to contract with a solvent reclaiming firm to meet the requirements of this Code.

Vapour Degreaser Start Up

Equipment manufacturers and producers of vapour degreasing solvents generally agree that the following procedures and practices should be followed when starting a vapour degreaser

- 1 Turn on condenser coolant system and check to ensure that it is operating properly
- 2 Turn on emission control, exhaust and ventilation equipment
- 3 Activate all control devices and safety switches on equipment and check periodically to ensure proper operation This includes the automatic heat shut-off thermostat above the condensing zone, maximum surface temperature controls on heating elements and maximum solvent temperature control in cleaning compartments
- 4 Add solvent to all compartments as necessary, taking care to avoid agitating the vapour zone Make sure there are at least six centimetres (two to three inches) of solvent above the heating coils to avoid overheating and decomposition of the solvent

Pumping the solvent into the degreaser through a submerged pipe or hose is recommended rather than pouring it directly from drums or pails Transferring solvent using pressurized air is not recommended

- 5 Check to ensure the degreaser covers are in place during idle periods and start up
- 6 Turn on heat supply and, if degreaser is steam heated, check settings to conform with those recommended for the solvent being used
- 7 As degreaser reaches operating temperature, adjust heat input so that the upper level of the vapour zone is at the midpoint of the condenser coils Maximum operating efficiency and minimum solvent losses are obtained when vapour generation is balanced by condensation from the workload and condensing coils
- 8 When the vapour zone has reached the condenser coils, check to ensure that the condensed solvent is flowing through the water separator and to the proper degreaser compartment
- 9 Check operation of spray pump and spray pump control switch (when provided)
- 10 Check all thermometers and gauges to ensure that readings are in the proper operating range
- 11 Start workload through the system
- 12 Check condenser coolant flow and outlet temperature(s) Adjust as necessary to ensure that the vapour level does not rise above the design or operating level and that condensation of moisture from room air on the condenser coils is minimized

- 13 Check that all coolant and heating lines are free of leaks and the water separator is functioning properly to prevent contamination in the degreaser

Vapour Degreaser Shut Down

When not in production, degreasers are normally shut down for economic reasons. The shut-down procedure is essentially the reverse of the start-up operation. The following steps are given as a guideline:

- 1 Stop processing work and clear the machine of all work
- 2 Shut off heat supply
- 3 Allow vapour level to drop below condenser coils
- 4 Shut down condenser coolant-supply system
- 5 Shut off exhaust fans and place covers on degreasers as required by this Code
- 6 Shut down auxiliary equipment and control devices in accordance with manufacturer's recommendations

Acid Degreaser Treatment

An "acid degreaser" is the result of decomposition of the degreasing solvent to acid products or parts. An acid degreaser may be recognized by the presence of a variety of symptoms including a strong acid odour, dense white acid smoke in the vapour zone, pitting and rusting of cleaned parts and loss of acid acceptance.

Treatment of an acid degreaser consists of neutralizing the acid solvent, draining the degreaser, cleaning the unit manually and neutralizing with a heated soda-ash solution.

Warning

An acid degreaser presents the potential of fire and explosion with consequent personal injury. A continuing acid reaction results in the formation of toxic gases, including hydrogen chloride and possible violent exothermic reactions with iron oxides and aluminum, when present in the sump. The acid degreaser should be neutralized immediately following procedures recommended by the solvent supplier.

If a degreaser is determined to have "gone acid", the following steps should be taken immediately

- 1 TURN OFF HEAT SOURCE TO THE DEGREASER Do not turn off the condenser coolant or the ventilation fans
- 2 SEND ALL UNNECESSARY PERSONNEL AWAY FROM THE AFFECTED AREA Those required to clean the unit must be properly trained and equipped for such exposure
- 3 INTRODUCE ENOUGH WATER INTO THE UNIT TO COVER ALL SOLVENT to a depth of 5-10 centimetres (2-4 inches) Add a water solution of soda ash (sodium carbonate) at a concentration of about 30-60 kilograms per cubic metre ($\frac{1}{4}$ to $\frac{1}{2}$ pounds per gallon) of water. This will help neutralize the acid decomposition and will facilitate cleaning the machine. DO NOT USE CAUSTIC SODA (sodium hydroxide) or CAUSTIC POTASH (potassium hydroxide) because an explosive product may result

Once the immediate steps have been taken, the degreaser should be thoroughly cleaned and neutralized. A complete recommended procedure for this cleanout may be found in ASTM Practice for Handling and Acid Degreaser or Still (D 4579)

Appendix D

Relative Effectiveness of Emission Control Measures

TABLE D-1

Effectiveness of OTVC Emission Control Measures (34)

Control Measures	Emission Reduction Efficiency (%)		
	Idling Emissions	Working Emissions	Downtime Emissions
Hoist @ 3.3 mpm Freeboard refrigeration (BF) 1.0 FBR	55 - 74	58 - 73	0
Hoist @ 3.3 mpm Enclosed design 2.0 FBR, sump cooling	53 - 74	66 - 78	90
Hoist @ 3.3 mpm Automated cover	41 - 48	57 - 62	0
Hoist @ 0.9 mpm Freeboard refrigeration (BF) 1.0 FBR	55 - 74	90	0
Hoist @ 0.9 mpm Enclosed design 1.0 FBR, sump cooling	53 - 74	91 - 95	90
Hoist @ 0.9 mpm Automated cover	41 - 48	89 - 91	0
mpm: metres per minute BF: below freezing FBR: freeboard ratio			

Source Reference Document *VOC Emission from Solvent Degreasing* prepared for Environment Canada by Energy Pathways Inc. in conjunction with H.W. Quinn Associates September 1993

TABLE D-2

Combined Control Efficiencies for Open-Top Degreasers¹

Level of Control²

40%	50%	60%	70%
FB Ratio = 1 →	+ Auto Cover →	+ FB Refrig →	
FB Ratio = 1 →	+ Dwell →		
FB Ratio = 1 →	+ Reduced Room Draft →		
Reduced Room Draft →	+ Dwell →	+ Auto Cover or FB Refrig →	
Reduced Room Draft →	+ FB Refrig →	+ Dwell →	
Reduced Room Draft →	+ Auto Cover →	+ Dwell →	
Dwell →	+ FB Ratio = 1 →		
Dwell →	+ FB Refrig →	+ Reduced Room Draft →	
Dwell →	+ Reduced Room Draft →	+ Auto Cover or FB Refrig →	

1 This chart summarizes information developed by EPA's Office of Air Quality Planning and Standards for its national emission standard for degreasing (EPA, 1992c). It is not intended as an evaluation of all available emission control options.

2 The level of control as determined by EPA, is a measure of the potential reduction in solvent loss (compared to uncontrolled emission) based on an operating schedule of 6 hours working, 2 hours idle, and 16 hours downtime for 260 days/year (EPA, 1992c). For the purpose of this chart, all degreasers are assumed to be equipped with a manual cover and a hoist operated at a vertical speed of 11 feet per minute (EPA, 1992c).

Level of Control

40%	50%	60%	70%
FB Refrig →	+ Auto Cover →		
FB Refrig →	+ Dwell →	+ Reduced Room Draft →	
Auto Cover →	+ Dwell or FB Ratio = 1 →		
Auto Cover →	+ Reduced Room Draft →	+ Dwell →	
Superheat Vapour →	+ FB Ratio = 1 or Dwell →	+ Reduced Room Draft →	
Superheat Vapour →	+ FB Refrig →	+ Auto Cover →	
Superheat Vapour →	+ Reduced Room Draft →	+ FB Refrig or Auto Cover →	

FB	— Freeboard
FB Ratio = 1	— Increase in freeboard ratio from 0.75 to 1.0
FB Refrig	— Freeboard refrigeration device
Auto Cover	— Automated (bi-parting) cover
Dwell	— Addition of a dwell time to the cleaning cycle during which parts are held above the vapor zone
Reduced Room Draft	— Reduction in room drafts from 100 to 50 ft per min
Superheat Vapor	— Inclusion of a superheated vapor cycle

Source: *Solvent cleaning (Degreasing)* published by the Centre for Emissions Control, Washington D.C., November 1992

Appendix E

Characteristics of Health, Safety and Environmental Management Systems

Characteristics of a Management System

For administering any one or all of the technical elements of a chemical process safety program like the one identified in the main body of this document, there are certain characteristics of a management system that should be in place to ensure that the program is carried out efficiently and effectively. These characteristics are sufficiently generic so as to apply to systems for managing virtually any important technical activity, however, they have particular value as a profile of the principal requirements of a management system for chemical process safety. Still, this list is not necessarily definitive. Not all features or characteristics may be needed in every specific company situation. Exceptions and departures based on local circumstances are acceptable. Also suggested changes and additions are encouraged. They follow.

PLANNING

Explicit Goals and Objectives

Goals describe the overall, long-range targets that the company seeks to achieve. Objectives translate the goals into more specific statements of purpose, that is, what it is the company is trying to gain from the activity.

Well-Defined Scope

Each element of a chemical process safety program, if it is to be well managed, requires a clear definition of its component parts or activities. For example, an effective program for incident investigation should have a well-defined means for addressing incident and near-miss recording, internal reporting, external notification, incident follow-up and resolution, and third-party review as needed. The boundaries of these activities need to be clearly understood and widely communicated within the organization.

Clear-Cut Desired Outputs

Wherever possible, planning for individual elements or component parts of a process safety management program should identify specific measures for desired outcomes and set target or desired levels for each. The measures selected should capture the benefits to the company of pursuing the particular activity and express them in terms that clearly communicate to management both the value of that activity and the extent of goal achievement.

Consideration of Alternative Achievement Mechanisms

Once the questions of what is to be accomplished and how much of it is desired have been answered, it still remains to process safety planners to determine *how* this will be done. Planners must be able to identify, evaluate, and ultimately choose among feasible technical and administrative means available to achieve the specified level of program outputs. The key to this process is the early and explicit consideration of alternatives. Different mechanisms for reaching program goals need to be assessed in terms of their efficiency and effectiveness of goal achievement as well as for their "fit" with company culture and values before a preferred approach is selected.

Well-Defined Inputs and Resource Requirements

Sound planning for chemical process safety requires an equal degree of specificity in determining the types and amount of personnel, financial, and technical resources needed to accomplish desired program outputs. These include not just headcount and capital and operating budget dollars, but also specific technical disciplines and skill levels among the available staff. Inputs and resource requirements will differ significantly, depending on whether the specific activity involves a single project having a finite beginning and end, an ongoing process, or a program composed of multiple processes having extensive feedback loops. In any of these situations, not only must inputs be identified as precisely as outputs, the levels of the two need to be consistent if management goals and objectives are to be achieved.

Identification of Needed Tools and Training

To carry out effectively approaches to achieving specific process safety management outputs may require use of specific tools, for example, diagnostic or measurement equipment, analytical methods, predictive models, and/or sophisticated computing and data management. The planning function must provide for these tools — in the types and quantities needed. It must also identify the specific skills training needs of company employees who will be assigned responsibilities for carrying on particular process safety management activities, including use of specialized tools.

ORGANIZING

Strong Sponsorship

Each technical element in a process safety management program needs to have a specific person or organizational unit clearly designated as responsible for its design, implementation, and maintenance as well as for proper review. Having this designated "champion" for the activity helps assure that it receives adequate management attention and support. The process safety management program as a whole requires a strong commitment from senior corporate management. For the program to be effective over the long term, management should make frequent clear statements to employees and the public about their expectations for the company's

process safety performance. They should underscore this commitment by regularly requesting information on the status of company safety activities.

Clear Lines of Authority

Not all technical elements of a chemical process safety program need report to the same responsible individual, but, collectively, the lines of reporting authority and accountability for the various specific elements should be direct and unambiguous. The organizational structure itself should promote clarity of understanding among all involved as to the chain of command and relevant approval/authorization requirements affecting process safety activities.

Explicit Assignments of Roles and Responsibilities

A management system for chemical process safety must identify specific activities under each technical element and assign responsibility for each to designated organizational units and individual job titles. These assignments should also be reinforced within the organization through detailed job descriptions, clear measures of job performance, and annual personnel reviews tied to performance factors.

Formal Procedures

A management system for chemical process safety further organizes and structures the work related to specific technical elements through development and use of formal written procedures. These procedures translate the roles and responsibilities of organizational units and individuals into well-defined task sequences for both one-time and ongoing process safety management activities. If followed, they help ensure consistent work performance designed to meet planned process safety objectives and desired outputs.

Internal Coordination and Communication

Well-designed management systems seek to eliminate organizational barriers to the coordination of process-safety-related activities across functional speciality lines, and to promote close working relationships among operating, engineering, research and development, safety, legal, and environmental personnel within the company. Organizations characterized by strong formal and informal networks of professionals sharing process safety consensus are frequently better able to identify potential new sources of hazards and to respond to them more quickly and effectively.

IMPLEMENTING

Detailed Work Plans

Ongoing activities under specific technical elements of the chemical process safety management program, as well as important new process-safety-related projects, should receive detailed management attention to work task identification, planning, staffing, budgeting, scheduling, and

review The benefits of such detailed planning include a sharper focus on obtaining desired safety results and increased management accountability for doing so

Specific Milestones for Accomplishments

As an outgrowth of detailed work planning an effective system for managing the implementation of process-safety-related activities and projects also stresses the identification of clear schedule targets for work accomplishment and key moments in time when management direction can be asserted to help guide achievement of program objectives Ongoing activities and special projects alike should be implemented in such a way as to make use of these schedule milestones as important devices for communicating management expectations for specific work performance

Initiating Mechanisms

For certain one-time and other nonroutine events and activities, a management system for chemical process safety must identify and provide for specific mechanisms that will trigger appropriate administrative actions as needed Examples include procedures that trigger safety reviews for requested process changes material substitutions, and major new capital equipment for both variance requests and pre-startup activity on selected types of projects

CONTROLLING

Performance Standards and Measurement Methods

Individual technical elements in a chemical process safety management program require establishing standards and criteria for determining acceptable levels of process functioning and work performance, for example, statistical process control standards, criteria for boiler test/inspection, and equipment preventive maintenance A management system must specify these standards as well as appropriate equipment and/or methodologies for measuring performance against them

Checks and Balances

From a process control standpoint some of the performance standards specified by the management system will be fault tolerances for specific excursions beyond desired ranges for such parameters as temperature, pressure, and level or weight The process safety management system must also spell out how the process (or processes) has been designed to tolerate faults and to respond appropriately (e g , systems and procedures for high and low alarms, second alarms, or automatic shutdown) For work performance standards as well, the management system must also provide guidance for acceptable deviations and appropriate response (e g How much time should elapse past a required inspection or maintenance activity date before follow-up should be initiated?)

Performance Measurement and Reporting

Using specified performance standards, fault tolerances, and measurement methods, a chemical process safety management system must provide for appropriate recording (automated or manual) of process/work performance information following well-defined documentation requirements. The system should also address the issue of efficient reporting of this information (e.g., which items at what level of aggregation, to whom, and how frequently).

Internal Reviews

In conjunction with specific milestone events and/or established control points, it is important that a management system for process safety incorporated requirements for internal monitoring of work performance/accomplishment versus schedule, as well as for interdisciplinary reviews of certain decisions (e.g., major capital investments, design approvals process and raw material changes, selected variance requests). These latter reviews should be structured so as to allow operating management to draw on, as needed, the specialized expertise of functional staff in engineering, research and development, medical, legal, and environmental health and safety.

Variance Procedure

A management system for process safety needs the flexibility to be able to recognize when the existence of special circumstances warrants temporary departures from established operating procedures. It also must have the internal controls to review these departures in advance, for any potentially significant safety risk, and then to limit them in scope and time to ones that can be managed in an acceptable manner.

Audit Mechanisms

Periodically, chemical process safety programs, including the management system, require a thorough audit of how well they are identifying, assessing, managing, and mitigating significant episodic and chronic process risks. A sound management system will provide for conducting such audits, covering all the technical elements, while focusing primarily on equipment design, operating conditions and procedures, safety systems, and management controls. The system should specify audit frequency as well as how the audits will be performed (e.g., by internal staff, outside consultants, or some combination of the two).

Corrective Action Mechanisms

When internal reviews or periodic audits identify deficiencies in one or more technical elements of a chemical process safety program, the management system must have the procedures in place to generate, evaluate, select, and implement appropriate, cost-effective technical and/or administrative solutions. These procedures must also provide for subsequent follow-up to determine whether the particular corrective action has successfully removed the deficiency, or if additional measures are required.

Procedure Renewal and Reauthorization

As processes, technologies, and operating environments change over time, there is a need to reexamine and reevaluate existing operating and control procedures and to modify them as appropriate. A management system for chemical process safety should reflect this need in a formal renewal/reauthorization step in which each major operating and control requirement is periodically subjected to a thorough multidisciplinary review in light of current plant practices and safety performance standards.