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**FLUOROCHEMICAL USE, DISTRIBUTION
AND RELEASE OVERVIEW**

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Prepared by
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FLUOROCHEMICAL USE, DISTRIBUTION AND RELEASE OVERVIEW

Introduction

This paper and accompanying appendices provide an overview of the use, distribution and environmental release of sulfonyl-based fluorochemicals (FCs) produced by 3M Company. The paper and appendices are intended to present a preliminary review of FC pathways for human and environmental exposure from the time these materials leave the control of 3M through their end-use and/or disposal. This assessment is primarily *qualitative* and is based on available information within 3M and the experience and judgment of 3M's FC marketing and technical support personnel.

3M undertook this review for two purposes: (i) to support initial judgments about the exposure scenarios of greatest significance and set priorities for in-depth quantitative evaluation of the use and disposal profile of selected FC products; and (ii) to guide and set priorities for product reformulation, customer communication and other product stewardship activities. Although the review is preliminary and qualitative, it may be useful in providing EPA and other agencies with an introduction to FC exposure issues.

3M has already taken a range of actions based on this preliminary review. These include product and environmental stewardship initiatives to reduce FC exposures and releases at 3M and downstream manufacturing locations. In addition, 3M is in the process of developing a comprehensive exposure assessment plan which will include further modeling, monitoring and product use simulations. Preliminary work to support this assessment is already underway. A summary of 3M's stewardship initiatives and exposure assessment workplan is presented in the final section of this paper.

Because the information in this paper and appendices is preliminary and qualitative, it contains some worst-case estimates of potential exposure and release levels. For this reason, the information in the paper should be used with caution. 3M expects that more realistic estimates of human exposure and environmental release levels will be available once its exposure assessment plan is implemented.

The 3M ECF Process

FCs are components of several important 3M product lines due to their unique and useful properties. As components of products, they repel both water and oil, reduce surface tension much lower than other surfactants, act as catalysts for oligomerization and polymerization, and function where other products would rapidly degrade.

3M Company utilizes a process known as Simons Electro-Chemical Fluorination (ECF) to synthesize organofluorine molecules. In this process, organic feedstocks are dispersed in liquid, anhydrous hydrogen fluoride, and an electric current is passed through the solution, causing the hydrogen atoms on the molecule to be replaced with fluorine. The predominant components of the products created by this process have the same carbon skeletal arrangement as the feedstock used, but with all of the hydrogen atoms replaced by fluorine. However, fragmentation and rearrangement of the carbon skeleton can also occur and significant amounts of cleaved, branched and cyclic structures may be formed. The degree of fluorination of the organic feedstock is also dependent upon the specific carbon chain length of the feedstock and parameters of the ECF process such as electrical current and the length of time the process is run. It is possible to synthesize fully fluorinated or perfluoroorganic molecules where all of the hydrogen atoms of the hydrocarbon feedstock have been replaced by fluorine atoms. Using these perfluoroorganic molecules as basic building blocks, unique chemistries can be created by further reactions with functionalized hydrocarbon molecules.

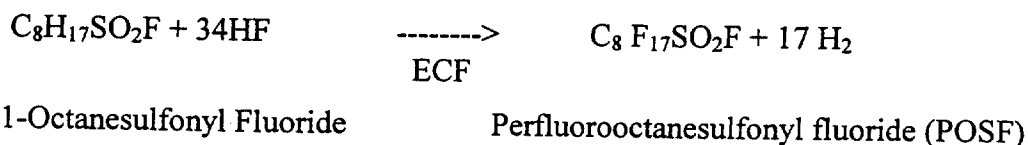
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3M built the first manufacturing pilot scale ECF process in 1949 and has continued to develop and improve the Simons ECF process for the production of fluorochemical products. Currently, 3M has three manufacturing sites in the United States using the ECF process (Cottage Grove (pilot production only), MN, Cordova, IL, and Decatur, AL). FC production using the ECF process occurs outside the United States at 3M's facility in Antwerp, Belgium.

3M Production of Sulfonyl-based Fluorochemicals

3M has produced sulfonyl based fluorochemicals commercially for over 40 years using the ECF process. A basic building block of such products and the highest production volume fluorochemical 3M manufactures is perfluorooctanesulfonyl fluoride (POSF). POSF is produced in the United States primarily at 3M's Decatur facility in quantities of around . The starting feedstock for producing POSF is 1-octanesulfonyl fluoride.

Reaction 1



The electrochemical fluorination process yields about 34%-40% straight chain (normal) POSF, and a mixture of byproducts and waste of variable composition. Because of slight differences in process conditions, raw materials, and equipment, the mixture produced by the electrochemical fluorination process varies somewhat from lot-to-lot and from plant-to-plant. The product that results from electrochemical fluorination is thus not a pure chemical but rather a mix of isomers and homologues.

During production, byproducts and waste products are formed. The volatile waste products, such as perfluoromethane, are vented to the atmosphere, but a program is underway to capture and destroy these releases by thermal oxidation. The tars formed in the process are incinerated at 3M corporate hazardous waste incinerator. The byproducts, many of which are incompletely fluorinated with hydrogen atoms still present, can be recycled back into the ECF process or are partially degraded in stabilization processes, and eventually discharged to controlled, in-house, wastewater treatment systems. The treatment sludge is either landfilled or land-incorporated. Some of the non-POSF byproducts are recovered and sold for secondary uses.

POSF is itself a commercially viable product, and in 1997 was sold in quantities of approximately for use as an industrial raw material (mainly outside the US). However, the primary use of POSF is within 3M, where it functions as an important intermediate in the synthesis of substances used in many other 3M fluorochemical products. The majority of internally-consumed POSF is used to produce functionally derivatized fluorochemicals and high molecular weight polymeric products. **Table 1** identifies POSF-based fluorochemicals, their acronyms, chemical names, and formulas. To a lesser extent, some homologues of POSF, $[\text{C}_n\text{F}_{(2n+1)}\text{SO}_2\text{F}]$ where $n \neq 8$, principally perfluorohexanesulfonyl fluoride, are also intermediates in the formation of other 3M products.

Perfluorooctane sulfonic acid (PFOS) will result from the chemical or metabolic hydrolysis of POSF-derived FCs. Under appropriate conditions, the perfluorooctane sulfonate anion can form salts with monovalent metallic cations. Current information indicates that PFOS or its salts cannot be broken down further

chemically under normally occurring environmental conditions. Therefore PFOS is the ultimate degradation product from POSF derived fluorochemicals and will generally persist in that form. PFOS is also a commercialized product used for a variety of surfactant applications (mainly fire-fighting foams and coating additives). 3M sells approximately

Using POSF as a basic building block, unique chemistries can be created by derivatizing POSF through the sulfonyl fluoride moiety of the molecule using conventional hydrocarbon reactions. Charts 1 and 2 outline the general classes of fluorinated materials made by 3M. The major intermediates are represented by the trunk of the "tree" in Chart 1. POSF is reacted with methyl or ethyl amine to produce either N-methyl or N-ethylperfluorooctanesulfonamide (FOSA). FOSA is subsequently reacted with ethylene carbonate to form either N-methyl or N-ethylperfluorooctanesulfonamidoethanol (FOSE). The FOSA and FOSE intermediates are the principal building blocks of 3M's product lines. By poundage, methyl-fose based intermediates and products slightly predominate over ethyl-fose-based materials.

The secondary reactions producing all of these derivatives are single or sequential batch processes that do not necessarily produce pure products. There may be varying amounts of fluorochemical residuals (unreacted or partially reacted starting materials or intermediates) that are carried forward to the final product. Examples of such residuals include PFOS, n-methyl and n-ethyl FOSA and N-MeFOSE and N-Et FOSE alcohols. Typically, where present, these residuals can be found at a concentration of 1-2% or less in final products and, in the aggregate, represent roughly 1-2% of total FC production volume. (FC residuals in 3M products have the potential to degrade or metabolize to PFOS.) In addition, during product use or disposal, the non-fluorochemical moieties added to the sulfonyl fluoride group of POSF can also be removed through a variety of degradation processes (chemical, environmental and metabolic). In such instances, the fluorochemical species which is ultimately produced as a result of such degradation will generally be PFOS as well.

3M Sulfonyl-based Fluorochemical Products

The 3M Chemical product lines that use POSF-based fluorochemicals are summarized below. In some cases, 3M manufactures the final commercialized product. In other cases, 3M sells a fluorochemical which another company incorporates into its final product. (Product lines using fluorochemicals which contain no sulfonyl groups are not listed).

POSF-derived fluorochemicals (polymers and monomers) are formulated with water or solvent, with the FC component (or FC solids) representing percent of the formulation. Total U.S. production of FC solids across 3M's product lines is about . 3M produced FC solids represent plus of the total production of sulfonyl based fluorochemicals in the U.S. The breakdown of 3M FC production into different product categories is shown in **Table 2**.

Surface Treatments (High Molecular Weight (MW) polymers or formulated products with low percentages of non-polymeric FC solids)

Carpet Protector
Fabric/Upholstery Protector
Apparel and Leather Protector
Protective Products for After Markets and Consumer Application

Paper and Packaging Protectors (Phosphate esters or high MW polymers)

Food Packaging

Paper Products

Performance Chemicals (Low MW chemical substances)

Fire Extinguishing Foam Concentrates
Mining and Oil Surfactants
Electroplating and Etching Bath Surfactants
Household Additives
Chemical Intermediates
Coatings and Coating Additives
Carpet Spot Cleaners
Insecticides Raw Materials

Surface treatment products for carpets, textiles and apparel are typically sold under the Scotchgard® tradename; 3M markets its paper and packaging protective products under the Scotchban® tradename; and some performance chemicals are sold under the Fluorad® tradename.

Surface Treatment Products. 3M fluorochemicals produced for surface treatment applications provide soil, stain, and water resistance to personal apparel and home furnishings. The great bulk of these products are manufactured as high-molecular weight polymers although some surface treatment products used for aftermarket and consumer spray application contain a significant fraction of unpolymerized FC components. Polymeric surface treatment products are primarily N-MeFOSEA-based; the fluorochemical is polymerized with urethane, acrylate and/or adipate reactants. Such protective products function through the fluorocarbon moiety on the polymer lowering the surface energy of the material to which they are applied.

Paper Protectors. The 3M paper protectors are used in food packaging and commercial applications. They can be divided into two general classes of chemistries. One class consists of mixtures of mono-, di- and tri-phosphate esters of N-EtFOSE alcohol, roughly in the proportions of 10%, 85% and 5% percent, respectively. The other class is N-MeFOSEA-acrylate copolymer. Applied to paper, the perfluorocarbon moiety in these classes of products has the effect of lowering the surface energy of the individual paper fibers. This lowered surface energy greatly contributes to the holdout of low surface energy liquids such as greases and oils.

Performance Chemicals. POSF derived chemistries used as performance chemicals are relatively low molecular weight (<500 daltons) surface active materials and monomers. Some of these chemicals are sold by 3M, or incorporated by 3M customers into formulated products, for use as surfactants in a range of industrial or consumer applications. Other performance chemicals are used as intermediates from which 3M or its customers make other finished products. Such fluorochemical intermediates can be covalently bound to a variety of polymeric hydrocarbon backbones to make higher molecular oligomeric or polymeric products with unique performance characteristics.

POSF-derived performance chemicals with fluorochemical surfactant properties differ greatly from conventional hydrocarbon and silicone surfactants. In most systems they are far more efficient in reducing surface tension to levels that are unreachable with other types of surfactants. In some aqueous systems, surface tensions as low as 15 to 16 dynes/cm can be attained. The fluorochemical surfactants normally produce these extremely low values at concentrations as low as 100 parts per million, or less. Equally important is the fact that certain of these fluorochemical surface active agents are stable and effective in many extremely hostile

environments, including strongly acidic, strongly alkaline and even strongly oxidizing systems. **Table 3** summarizes the features of fluorochemical surfactants.

Another unique physical characteristic of certain POSF-based performance chemicals is their ability to form tough, yet resilient foams. Such foams usually contain low molecular weight fluorochemicals (including PFOS) and have been formulated to resist the action of high temperature or aggressive chemicals and vapors. These formulations have found commercial application in suppressing flammable liquid, chemical and organic fires or toxic and obnoxious vapors and odors.

Profile of Major Product Categories

The Appendices to this paper provide detailed profiles of each of the major use categories for sulfonyl-based FCs. For each use category, the Appendices present:

- Chemical composition information for 3M products.
- A description of the relevant business, including the scope of FC usage and distribution and location of key customers.
- A synopsis of use and distribution patterns, including potential exposure pathways during the initial application of FCs by 3M's customers, potential environmental release scenarios and opportunities for exposure during end-use of products to which FCs are applied.

Key information about each use category is highlighted below.

Surface Treatment Products

- These products provide soil resistance and repellency (fluorochemical products). Industrial, non-retail customers for products in this class consist of (i) carpet manufacturers and fiber producers who serve the markets for residential, commercial and transportation flooring; (ii) textile mills and commission finishers who produce upholstery fabric for residential furniture, home decor items such as slipcovers, mattress pads and shower curtains, and automotive, truck and van interiors or produce non-woven fabrics for use in medical or industrial applications; and (iii) textile mills, leather tanneries, finishers and chemical formulators who treat fabric and leather used for garments, footwear, accessories and non-garment functional fabrics.
- These products consist of polymeric FCs with high molecular weights. Industrial, commercial and consumer exposure is primarily to polymeric substances, although most of the 3M products contain low amounts of monomeric FC residuals (typically at 1 percent or lower levels) to which some exposure may occur.
- Upon distribution to mills, fiber manufacturers or other customers, the 3M surface treatment product is typically mixed with other additives and diluted. It is then applied to uncut fiber, textile or leather raw materials. Application methods include spray, foam, pad or co-application. Depending on the market segment, the application process occurs in an enclosed or open operation. In the latter case, mill production workers could have inhalation

and/or dermal exposure to FCs although such exposure would be predominantly to polymers. Some additional exposure may occur during processing operations such as drying, shearing, cutting and shipping although exposure levels should be low.

- Losses of FC polymers to the environment are expected during 3M customer operations. These losses could involve discharges of process wastewater and air releases during initial application of surface treatment formulations to uncut carpet, fiber, fabric or leather. Additional wastes (typically solids coated with FC polymers) are created during cutting, shearing and other packaging operations and are typically landfilled or recycled. Total FC losses during downstream operations will vary by application but it is estimated that they could range between
- The end-use of consumer articles is another source of FC losses to the environment. For example, vacuuming and cleaning of carpets is estimated to result in substantial removal of the FC treatment over time; carpet containing FC coatings is also landfilled upon end-of-life disposal. Similarly, FC losses to the environment are also expected in wastewater from dry cleaning and laundering of garments, upholstery and leather goods and from landfilling of these items after they are discarded.
- 3M surface treatment products have extensive aftermarket applications and are distributed through retail and commercial channels for direct treatment of upholstery, carpet, auto interiors, apparel and leather by individual consumers or professional applicators.
- Retail products in this category are aerosol can spray cleaners and protectors for residential use. These products are manufactured by independent non-3M facilities under contract with 3M and are distributed through grocery, hardware and autoparts stores and other retail outlets. A variety of formulations are manufactured for this market. Typically, they include non-polymeric fluorochemical salts and residuals at levels of between . These have the potential to degrade to PFOS. These products are intended for occasional home use only.
- Commercial 3M surface treatment products are marketed to (i) commercial cleaning services and (ii) commercial film processing facilities. Products in the first category are liquid, water-based materials applied through low-pressure or paint-type spray equipment to upholstery, carpet and other surfaces in homes, commercial buildings or retail furniture outlets. These products contain non-polymeric FC solids and residuals in concentrations of between . The second class of products includes liquid, photocurable coating for film negatives which is typically machine-applied at commercial film processing facilities.

Paper and Packaging Protectors

- 3M markets fluorochemical sizing agents to the packaging and paper industries. These products impart grease, oil and water resistance to paper and paperboard substrates. They are used for food contact applications (plates, food containers, bags and wraps) and non-food applications (folding cartons, containers and carbonless forms and masking papers).

- Fluorochemical sizing agents are applied to paper and paperboard substrates predominantly by paper mills which treat paper fibers and, to a much lesser extent, by converters who transform paper and/or paperboard into wraps, bags or cartons for desired end-uses. Application methods vary but approximately 75 percent of paper mill use of these products occurs via the size press. The fluorochemical product received by 3M customers is typically diluted in a starch/ water solution and applied in a concentration to the paper web, which is then dried to evaporate the water and converted into rolls for shipment. Mix preparation, treatment of the paper web, and conversion are all carried out in open systems although fluorochemical exposure to workers is generally considered to be limited because of the dilute form of the sizing mixture and predominance of high molecular weight FC esters or polymers. Some loss of the fluorochemicals to the environment occurs as a result of spillage, cleanup and releases during the opening, rinsing and recovery of FC totes or drums. Environmental media for FC releases include wastewater and air (for losses during papermaking) and landfills (for disposal of end-use paper products).
- 3M's food packaging products include a high molecular weight phosphate ester produced using N-EtFOSE and an acrylate copolymer based on N-MeFOSEA. Both of these products are regulated by the Food and Drug Administration (FDA) for direct food contact under 21 C.F.R. 176.170. The first product has been subject to considerable dialogue between FDA and 3M as a result of a petition for approval for microwave popcorn applications filed by 3M. In a risk assessment recently submitted to FDA in connection with this petition, 3M presented analyzes indicating that PFOS could be formed *in vivo* as a result of the hydrolysis of certain product components and the metabolic conversion of FC residuals.¹
- 3M's grease, oil and water repellant products for non-FDA applications are similar in composition to its food contact products. Consumer exposure to the FC residuals is expected to be minimal because use scenarios for paper and packaging products containing them involve very occasional dermal contact.

¹Environ Corporation, *Revised Interim Safety Assessment of FC-807 and 807A: Two Fluorochemical-based Indirect Food Additives*, January 25, 1999.

Performance Chemicals

- Products in this category are distributed for a variety of specialized industrial, commercial and consumer applications, often where the surfactant properties of fluorochemicals offer significant benefits. Many of these products are low molecular weight POSF-derived chemistries; some are fluorochemical intermediates covalently bonded to a variety of polymeric hydrocarbon backbones. Since these products tend to serve niche markets, volumes are generally small.
- *Fire Fighting Foams.* Light Water® and ATC® are trademarks for 3M products that are aqueous film forming foams (AFFF) and alcohol-resistant concentrate (AR-AFFF) used to suppress and/or extinguish flammable liquid fires and suppress flammable liquid and toxic chemical vapors. The great bulk of these products are sold to "fire fighters" who mix the concentrate with water to form a foam and apply it to the fire or flammable liquid either manually or through an automated system. User categories for the foams include chemical and petroleum plants, fire departments, vessels, off-shore drilling platforms, the military, and environmental remediation companies. The 3M foam products contain low concentrations which is typically present at levels of _____ in the foam as applied. After application, the foam is disposed of, typically through wastewater treatment, but uncontrolled releases to surface water or land are known to occur.
- *Mining and Oil Surfactants.* 3M sells surfactants to copper and gold mines to increase wetting of the sulfuric acid or cyanide that leaches the ore, enhancing the amount of metal recovery. Oil well service firms and oil companies also use these surfactants in a "well stimulation" formulation that is injected into wells to enhance oil or gas recovery. These products contain low molecular weight FCs

present at low levels in the range of _____

- *Metal Plating and Electronic Etching Baths.* Users of 3M surfactants in this category include chrome and plastic preplate etchant platers seeking to suppress oxidizing mist for purposes of worker protection. 3M surfactants are sold either as powders to formulators or as liquids directly to platers. Electronics manufacturers also add 3M surfactants as strong acids in order to etch precise patterns in a silicon wafer or a printed circuit board. The 3M products are

_____ . As distributed to formulators, these products typically contain FC solids at levels of _____ or higher but are diluted down to concentrations of _____ when added to metal plating or electronic etching baths. Because of the presence of strong acids and other corrosive materials, workers who prepare and apply the baths normally use personal protective equipment. Disposal of the spent baths is either to wastewater treatment facilities or to hazardous waste landfills or incinerators when the baths qualify as hazardous waste for purposes of RCRA.

- *Household Additives.* 3M surfactants are now (or previously have been) sold to a variety of formulators to improve the wetting of water-based products marketed as alkaline cleaners, floor polishes, photographic film, denture cleansers and shampoos. Several of these products (alkaline cleaners, floor polishes, shampoos) are (or previously were) marketed to consumers; some products are also sold to janitorial and commercial cleaning services. Some of the alkaline cleaners are spray-applied and could result in inhalation or ingestion exposure. The primary exposure route for other products is dermal. The 3M surfactants are

As supplied to formulators,

the 3M products contain in the range of FC solids but are then heavily diluted and are present in final products at extremely low levels

- *Intermediates.* 3M sells limited quantities of fluorochemical intermediates which are combined with other monomers to produce polymers. The intermediates sold by 3M in the U.S. include, fluorinated alkyl acrylate and fluorinated alkyl alcohol. Polymers produced by 3M customers are believed to have trace levels of FC residuals.
- *Coatings and Coating Additives.* 3M sells fluorochemical polymer coatings and coating additives which are used as received or diluted with water or butyl acetate to impart soil or water repellency to surfaces (including printed circuit boards or photographic film). These polymers contain FC residuals in low levels (typically 4% or less). Other formulators add 3M fluorochemical polymers as a thickener to aqueous coatings used to protect tile, marble and concrete. Products in this class have some distribution to commercial and consumer channels.
- *Carpet Spot Cleaner.* 3M supplies a non-polymeric fluorochemical to formulators of carpet spot cleaners in which the fluorochemical provides stain and soil resistance. These products are marketed to consumers in pump and aerosol cans for spray application to carpets. The FC component of these products is present at levels of
- *Insecticides Raw Materials.* The 3M products are processed by 3M customers into active ingredients in bait stations for leaf cutter ants, pharaoh ants, cornfield ants and a variety of household ants. These products are used mainly in commercial and industrial applications. The fluorochemicals are present in the pesticide formulation at levels of

Ongoing and Proposed Exposure Assessment and Stewardship Initiatives

Based on the results of its initial product use, distribution, and release overview, 3M has undertaken or is planning a variety of stewardship and exposure assessment initiatives intended to better characterize the highest priority human and environmental exposure pathways while taking initial steps to minimize exposure and release levels for products containing PFOS or PFOS precursors.

3M has undertaken extensive research and development programs to reengineer POSF-based products to reduce PFOS and precursor residuals and ultimately to transition to chemistries with lower accumulation potential.

3M has updated fluorochemical based MSDS's and has begun an industrial hygiene program with customers aimed at helping to promote improved use and handling of fluorochemicals and reduction of occupational exposures where appropriate. As part of this program, 3M has volunteered to make available its industrial hygiene professionals for qualitative workplace assessments at customer facilities. 3M is also conducting use simulation studies to determine potential consumer exposure levels for FCs released during spray application of surface treatment products marketed to consumers.

Exposure Assessment Plan Overview

Building on 3M's initial assessment a plan also has been developed to assess potential environmental exposure pathways associated with the manufacture, use and disposition of major 3M fluorochemical products. A detailed description of all the exposure/product stewardship initiatives is beyond the scope of this paper but the four principle components are as follows:

- 1) The characterization of fate and transport properties is being addressed in multiple steps. The specific projects planned and/or initiated to characterize fate and transport properties of fluorochemicals are:
 - a) Physical/chemical properties testing of persistent fluorochemical degradation products as well as selected fluorochemical products. This includes (where applicable): melting point, boiling point, vapor pressure, disassociation constant, hydrolysis, water solubility, air/water partition coefficient, octanol/water partition coefficient, soil/water partition coefficient, bioconcentration in fish.
 - b) Photodegradation studies
 - c) Atmospheric chemistry evaluation
 - d) Studies to assess aerobic and anaerobic biodegradability
 - e) Development of appropriate models for the prediction of physical/chemical properties of fluorochemicals not tested.
- 2) Using the initial estimates in the attached assessment and sales data from 1997, releases from manufacturing, the supply chain, use and disposal at all steps are being estimated for the products identified as important. Release data is also being determined by sampling and analyses of 3M manufacturing plant process wastes and effluents. In addition to providing the information necessary to assess distribution and exposure, release estimates will aid in determining sampling sites and substantiate results from sampling. It is anticipated that this effort may also identify those fluorochemicals which require further analysis of fate, transport and exposure.
- 3) Modeling and sampling is being undertaken to estimate fluorochemical concentrations and better characterize the distribution of FCs in the environment. These activities are to be conducted in an iterative fashion and will become refined and focused as more data become available. The specific projects planned and/or initiated to characterize environmental distribution are:

- 4) Exposure levels for all possible pathways that could lead to human ecological exposure from the prioritized products will be estimated. When release and distribution data become available, the most important pathways will be hypothesized. Iterative sampling and modeling will be employed to test these hypotheses and determine the important pathways to be used in risk assessment. The specific projects planned and/or initiated to estimate exposure are:

SUMMARY

Efforts are underway at 3M to assess the risk of POSF based 3M fluorochemicals to both human health and the environment. To augment 3M's initial review an exposure assessment plan for POSF based fluorochemicals is being implemented. As new information becomes available it will be summarized and communicated to the EPA. A POSF based fluorochemical environmental "white paper" is currently being prepared and will be submitted upon completion.

Chart 1

POSF Fluorochemical Reaction Tree

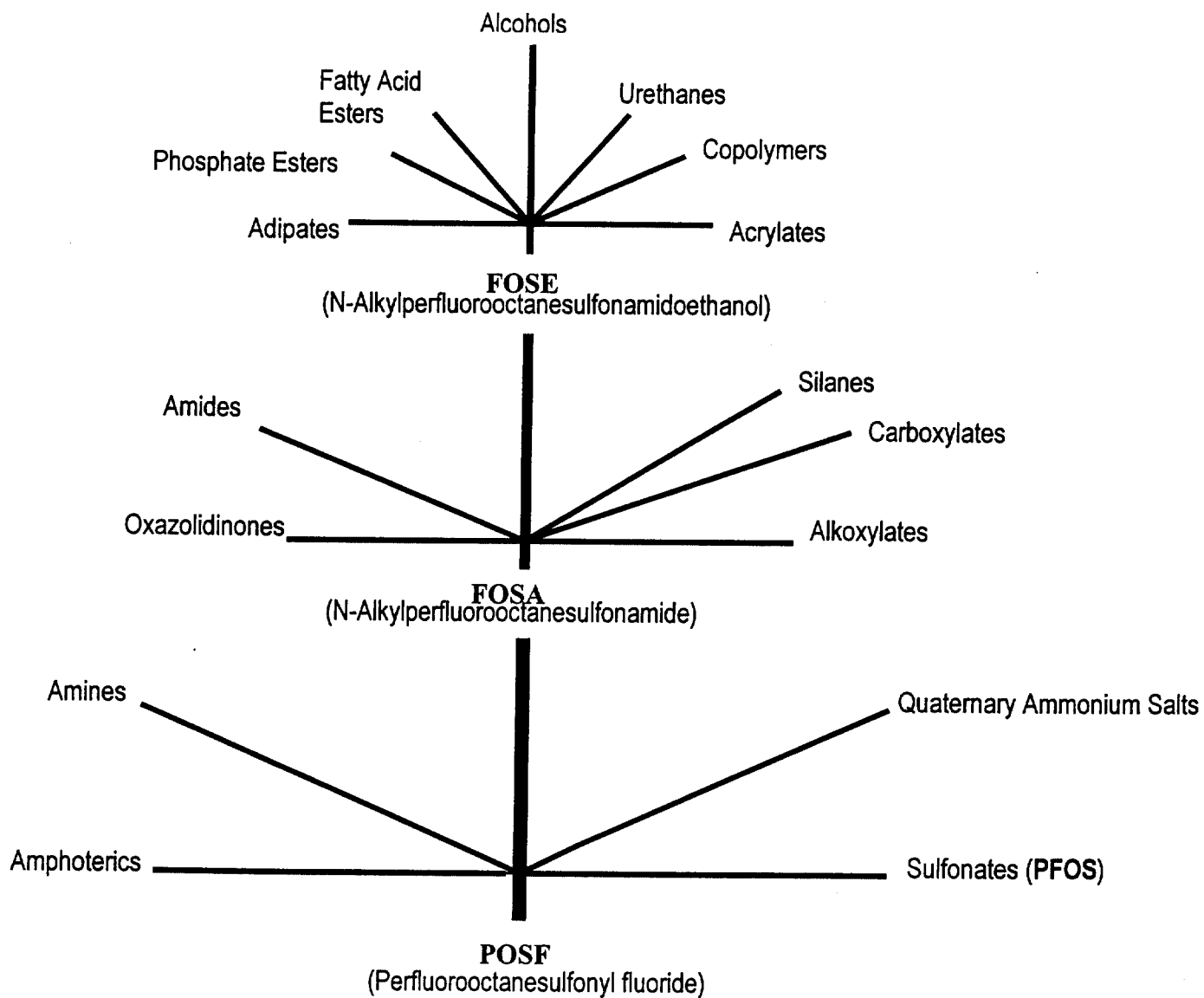


Table 1. Fluorochemical Glossary

Designation	Molecular Formula	Technical Name (CAS Name)
POSF	$C_8F_{17}SO_2F$	Perfluorooctanesulfonyl fluoride (1-Octanesulfonyl fluoride, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-)
PFOS	$C_8F_{17}SO_3^-$	Perfluorooctanesulfonate (1-Octanesulfonic acid anion, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-)
PFOSH	$C_8F_{17}SO_3H$	Perfluorooctanesulfonic acid (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-)
PFOS.NH ₄ salt	$C_8F_{17}SO_3NH_4$	Ammonium perfluorooctanesulfonate (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-, ammonium salt)
PFOS.DEA salt	$C_8F_{17}SO_3NH(CH_2CH_2OH)_2$	Perfluorooctanesulfonate, diethanolamine salt (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-, compd. with 2,2'-iminobis[ethanol] (1:1))
PFOS.K salt	$C_8F_{17}SO_3K$	Potassium perfluorooctanesulfonate (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-, potassium salt)
PFOS.Li salt	$C_8F_{17}SO_3Li$	Lithium perfluorooctanesulfonate (1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-, lithium salt)
FOSA	$C_8F_{17}SO_2NH_2$	Perfluorooctanesulfonamide (1-Octanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-)
N-EtFOSGE	$C_8F_{17}SO_2N(CH_2CH_3)CH_2COO^-$	N-perfluorooctylsulfonyl-N-ethylglycinate (Glycine, N-ethyl-N-[(heptafluorooctyl)sulfonyl]-, anion)
N-EtFOSA	$C_8F_{17}SO_2NHCH_2CH_3$	N-Ethylperfluorooctanesulfonamide (1-Octanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-)
N-MeFOSA	$C_8F_{17}SO_2NHCH_3$	N-Methylperfluorooctanesulfonamide (1-Octanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-N-methyl-)
N-EtFOSE	$C_8F_{17}SO_2N(CH_2CH_3)CH_2CH_2OH$	N-Ethylperfluorooctanesulfonamidoethanol (1-Octanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-N-(2-hydroxyethyl)-)
N-MeFOSE	$C_8F_{17}SO_2N(CH_3)CH_2CH_2OH$	N-Methylperfluorooctanesulfonamidoethanol (1-Octanesulfonamide, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptafluoro-N-(2-hydroxyethyl)-N-methyl-)
N-EtFOSEA	$C_8F_{17}SO_2N(CH_2CH_3)CH_2CH_2OCOCH=CH_2$	N-Ethylperfluorooctanesulfonamidoethyl acrylate (2-Propenoic acid, 2-[ethyl[(heptafluorooctyl)sulfonyl]amino]ethyl ester)
N-EtFOSEMA	$C_8F_{17}SO_2N(CH_2CH_3)CH_2CH_2OCOC(CH_3)=CH_2$	N-Ethylperfluorooctanesulfonamidoethyl methacrylate (2-Propenoic acid, 2-methyl-, 2-[ethyl[(heptafluorooctyl)sulfonyl]amino]ethyl ester)
N-MeFOSEA	$C_8F_{17}SO_2N(CH_3)CH_2CH_2OCOCH=CH_2$	N-Methylperfluorooctanesulfonamidoethyl acrylate (2-Propenoic acid, 2-[[[heptafluorooctyl)sulfonyl]methylamino]ethyl ester)



Table 3
Features of Fluorochemical Surfactants

SURFACE ACTIVITY

AQUEOUS SYSTEMS

Some of these surfactants can lower surface tension to less than 16 dynes/cm and function at low concentrations. They are effective in dramatically reducing surface tension in a wide variety of aqueous media, including acidic and basic systems.

NON AQUEOUS SYSTEMS

Fluorochemical Surfactants have been developed which uniquely reduce surface tensions of many organic media to about 20 dynes/cm, including solvents such as esters, alcohols and ethers and resin systems including epoxies, polyesters, urethanes and acrylics.

WETTING

Reduced surface tensions result in the ability to improve the wetting of a variety of materials, including such hard to wet surfaces as plastics and oily metals.

BETTER SPREADING

Low surface tension in combination with low interfacial tension affects spontaneous spreading of a liquid over various surfaces. This is important in reducing pinholes, craters, and edge crawling of coatings applied to unclean surfaces.

REDUCED WATER SPOTTING

Because of reduced droplet formation, the need for distilled or deionized water in rinsing operations may be eliminated.

SMALLER GAS BUBBLES

These smaller gas bubbles produced at the surface of metal during chemical etching will have less tendency to adhere, grow and cause surface imperfections.

SMALLER DROP FORMATION

Smaller drops are desired in fine aerosol mists.

BETTER LIQUID PENETRATION

The force required to cause liquids to move through small pore spaces can be greatly reduced.

IMPROVED FILM UNIFORMITY

Smoother, more even films are produced from polishes, finishes and coatings.

LEVELING

Emulsion coatings applied to difficult to wet surfaces can show greatly improved leveling with the addition of small quantities of these materials.

FOAMING

Stable foams can be produced in hostile media such as chromic acid or sodium hydroxide, where conventional surface active agents would be destroyed.

EMULSIFICATION

While generally not effective as emulsifiers in water-organic systems, these materials can be quite efficient emulsifiers in specialty applications, where fluorinated materials comprise either the continuous or the dispersed phase.

STABILITY

Chemical

Some of these surface active agents are stable in such rigorous environments as hot chromic acid, anhydrous hydrazine, hot concentrated sulfuric acid, hot concentrated hydrofluoric acid and hot concentrated sodium hydroxide solutions.

Thermal

While all of these materials have very good stability at moderate temperatures, a few can withstand temperatures in excess of 300°F in air.

LOW CONCENTRATION

These materials are normally effective at extremely low concentrations, and often are utilized at concentrations of 100 parts per million active solids or less.



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**Protective Chemical Products
Carpet Business**

**Fluorochemical Use, Distribution,
and Release Overview**

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Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in the Floorcoverings business. It attempts to answer the following questions.

- What products are customers exposed to?
- Where does exposure happen?
- What type of exposure is it?

The 3M fluorochemical business is complex and global. Markets served are highly fragmented involving multiple 3M products that are applied to multiple substrates, sold into multiple market segments and used for multiple end products.

Sources

Information for this report was developed solely from internal 3M sources. These include:

- Knowledge of product handling and use practices from field sales and technical personnel
- Best estimates of end-use applications from known customer activities.
- Internal sales reports
- Knowledge of worldwide activities (where applicable) by St Paul-based personnel

How To Read This Report

Situation Analysis:

Provides background on business and products.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical throughout the distribution chain to final end user. Objective is to identify all points of contact with our chemicals – from arrival on customer's loading dock through product usage and disposal.

Exposure Information Charts:

Attempts to quantify type and length of exposure and number of workers exposed to our chemicals within the distribution chain.

Summary Table:

Combines 3M product detail with the exposure routes to provide a summary of total business exposure by product type.

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Table of Contents

- I. Chemical Names
- II. Situation Analysis
 - A. Business Definition
 - B. Market Segments
 - C. Fluorochemical Usage
 - D. Customer Location Map
- III. Exposure Assessment
 - A. Distribution Chain / Points of Contact
 - B. Exposure Routes
 - C. Application Methods and Disposal
 - D. End User Information
 - E. Summary Table

Chemical Names

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Chemical Names

The following is a list of Chemical Abstract Services (CAS) names and numbers for individual products. The following information is presented:

Generic Code: Indicates an internal 3M designation of the product(s).

CAS Number: Indicates the Chemical Abstracts Services number(s) of fluorochemicals contained within each product.

Chemical Name (complete CAS name or IUPAC names if CAS name does not exist): Indicates the Chemical Abstracts Services name(s) of fluorochemicals contained within each product.

Chemical Class: Indicates a shortened, generic chemical name.

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Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Carpet			
CP-1, CP-2, CP-3, CP-5, CP-6			
CP-2			
CP-5, CP-6			
CP-7			
CP-3			
CP-4			

Situation Analysis

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Situation Analysis – Flooring Business Segment

Business Definition

This segment is comprised of carpet manufacturers and fiber producers to whom we supply fluorochemical and stainblocker protective treatments for carpet. These products provide soil resistance and repellency (fluorochemical products) and stain resistance (stainblockers).

The Flooring Business Unit defines its market by the following segments:

- Residential Carpet
- Commercial Carpet
- Transportation Carpet
- Area Rugs (minimal activity)

The following two pages further depict the Flooring Market Segment and our business in those segments:

1998 U.S. Flooring Market Segments

<i>Residential Carpet</i>	<i>Commercial Carpet</i>	<i>Transportation Carpet</i>	<i>Area Rugs</i>
• Replacement DIY Professional • Res. Contract New construction Tenant improvement	• Specifier Office Hospitality Institutional Retail • Main Street	• Automotive OEM Replacement Throw Mats • Mobile Homes • Recreational Vehicles Motor Homes Marine • Airline	• Tufted Rugs • Scatter Rugs • Indoor/Outdoor/Grass • Braided/Woven
ds. 912	363	108	181

000030

Fluorochemical Usage

This table is simply a breakdown of fluorochemical products by volume. These volumes are then further divided by application method. These numbers are based on sales volumes and 3M sources including sales, technical service, and marketing.

000031



Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

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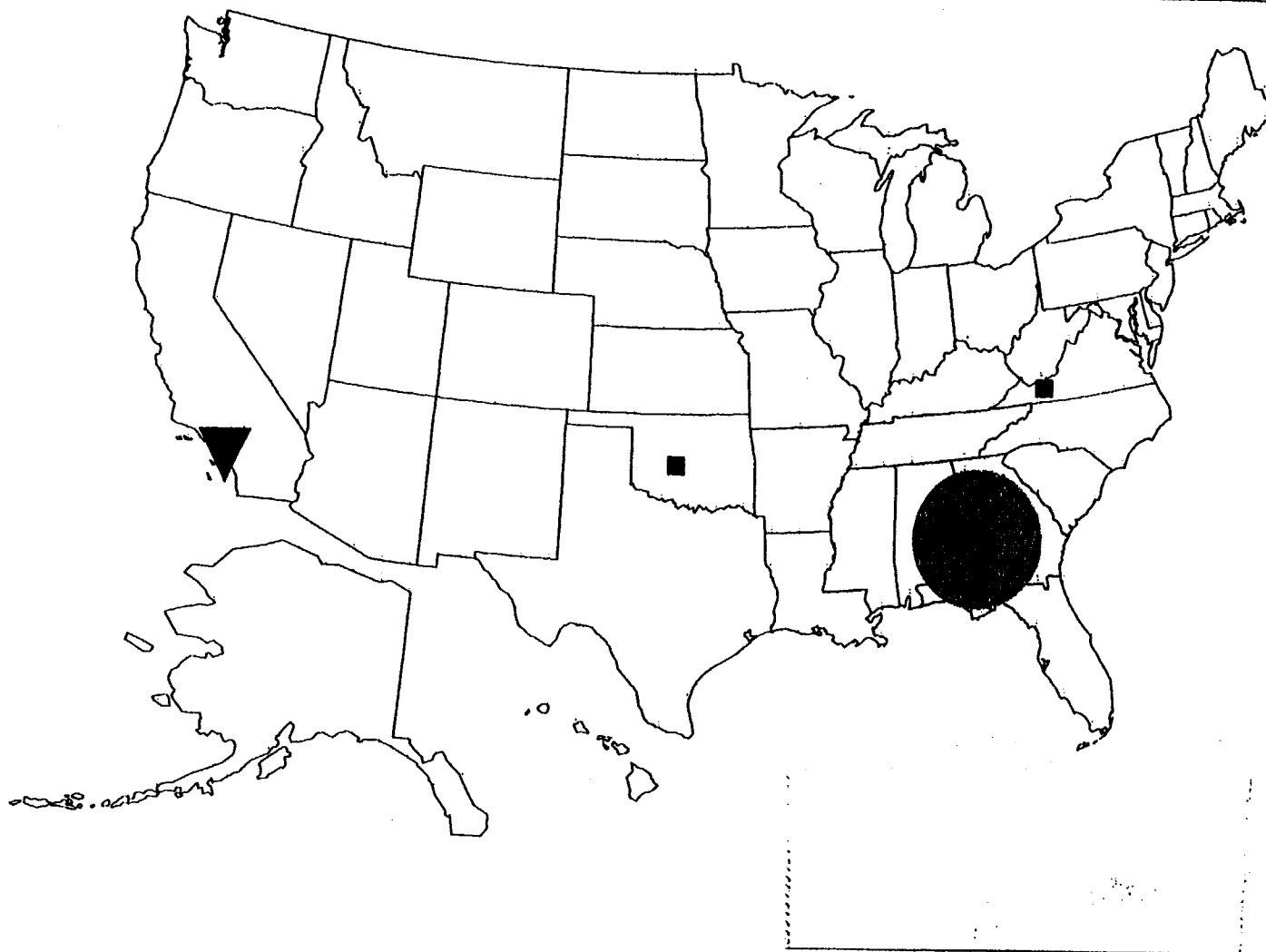
Product Volumes and Use Patterns

Product Code	Process or End Use	Volume Sold	Chemistry	% Residuals	Use Pattern				Route of Exposure			Environmental Fate				Comments
		M lbs. of FC Solids		% In Prod.	Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
CP-1	Fiber Treatment			1		X			X			X	X			
CP-2	Carpet Treatment			0.3		X			X	from spray	from spray	X	X	from application		
CP-3	Fiber Treatment			0.3		X			X			X	X			
CP-4	Fiber Treatment			0.3		X			X			X	X			
CP-5	Carpet Treatment			3 to 5		X			X	from spray	from spray	X	X	from application		
CP-6	Carpet Treatment			3 to 5		X			X	from spray	from spray	X	X	from application		
CP-7	Carpet Treatment			0.3		X			X			X	X	from application		
Finished goods	Carpet							X	X			X	X	from cleaning		

Customer Location Map

The following U.S. map identifies the location of chemical purchasing customers in the Floorings market segment. The grayscale key indicates where application of 3M fluorochemicals for carpet occurs. Treated goods are found throughout the United States.

Carpet Treatment Breakdown



Exposure Information

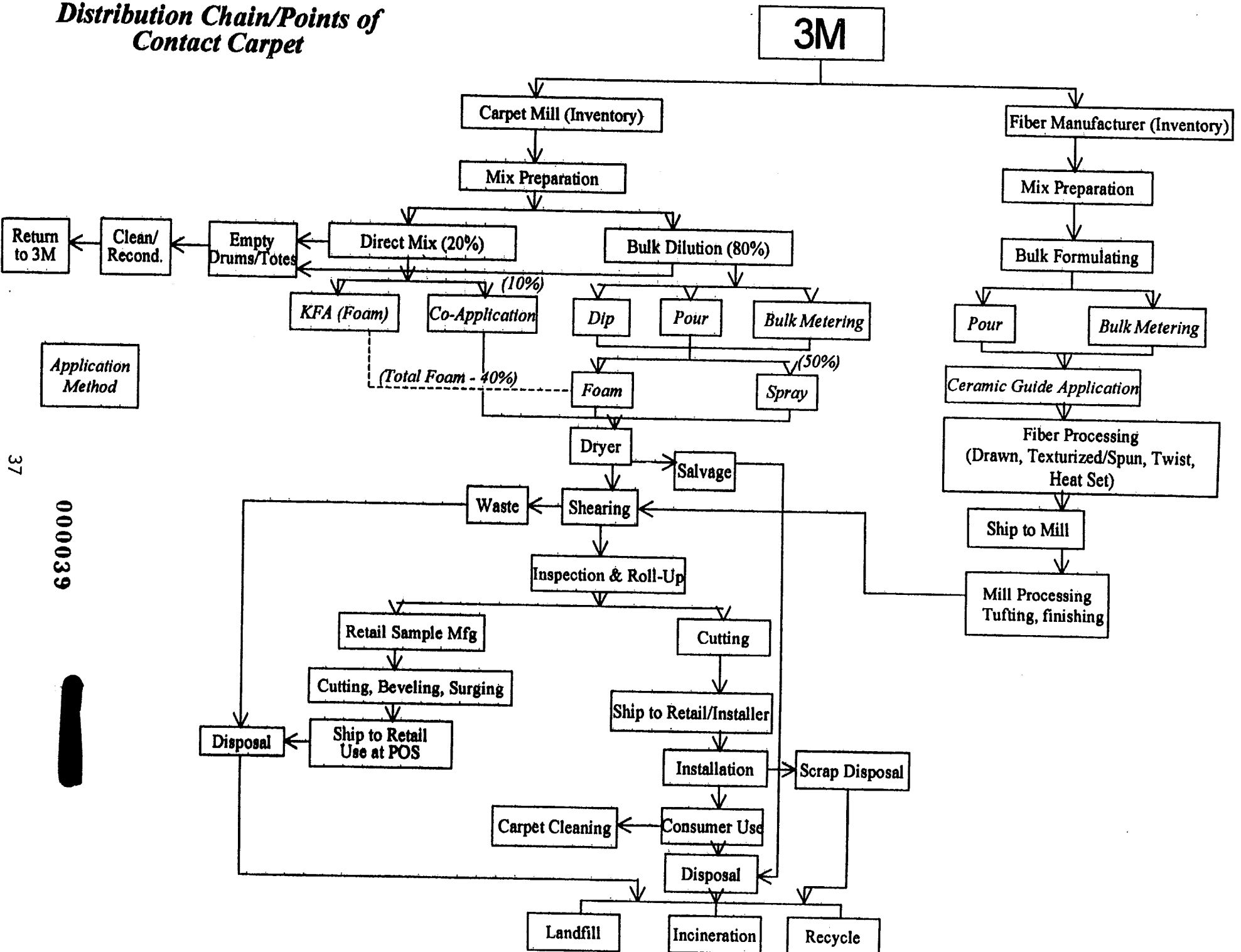
000037

Distribution Chain / Points of Contact

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of both the distribution chain and the significant points of contact where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

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Distribution Chain/Points of Contact Carpet



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

000040

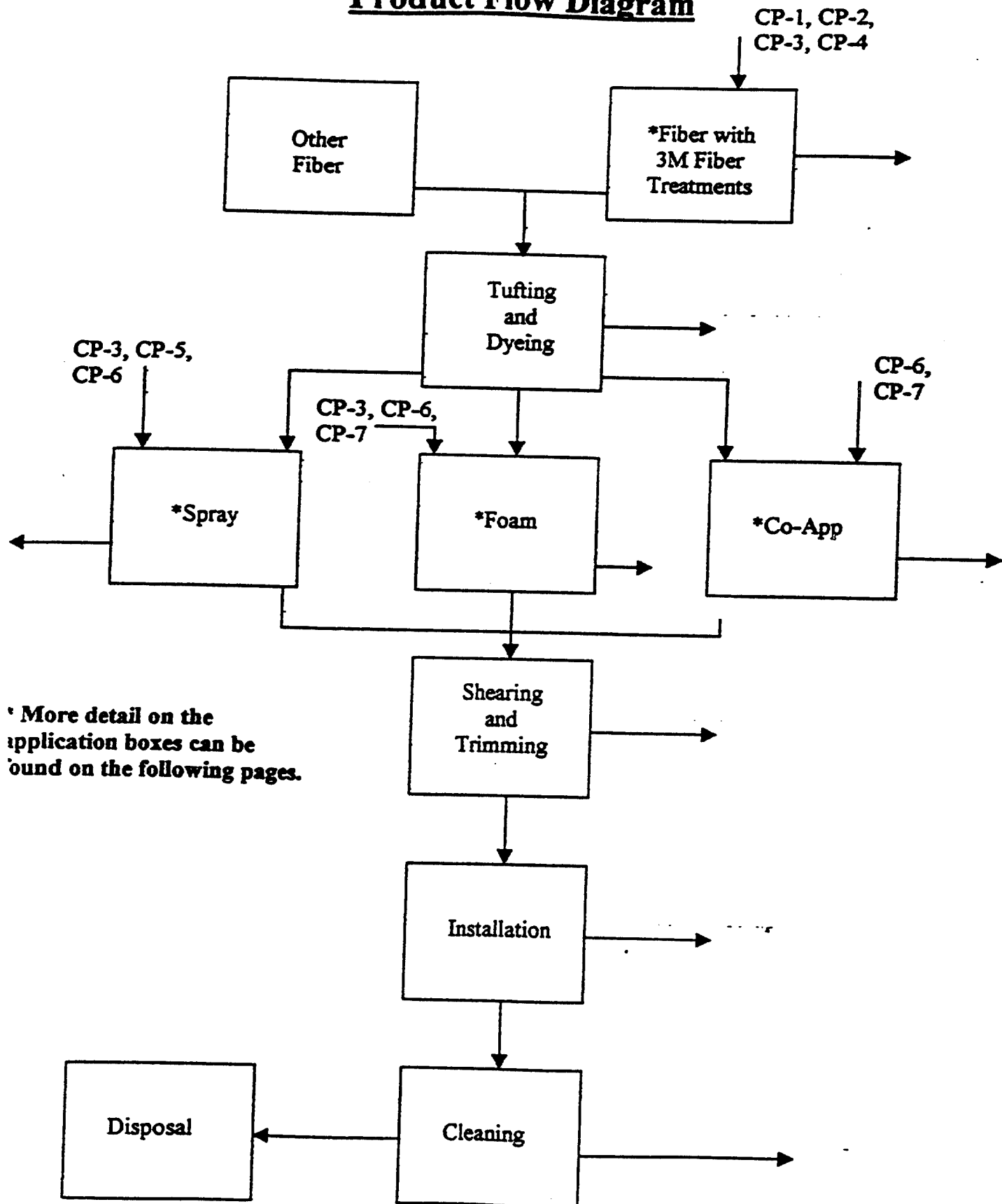
Point of Contact	Type of Exposure			Number of Workers (per line)	Exposure Times		Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation		Hrs/Day <1 = Low 1-4 = Medium >4 = High	Days/Year <50 = Low 50-100 = Medium >100 = High	Liquid	Solid	Aerosol	Vapor	Open	Closed	
Carpet Mill													
Loading Dock		X		1-3	L	L	X				X		Low Incidence, Conc Product
Tufting	X	X	X	2	H	H		X			X		
Mix Preparation													
Bulk Metering		X		2	M	H	X	X			X		Concentrated Product
Dip		X		2	M	H	X	X			X		Concentrated Product
Application													
Co-App				2	L	L	X	X				X	Primarily CP-7
Foam				2	L	H	X	X			X		
Spray	X	X	X	5	H	H	X	X	X	X	X		Primarily CP-8
Drying Oven			X	1	H	H			X	X	X		Possible Volatilized Residuals
Seaming & Salvage		X		2	H	H		X			X		Handling Finished Goods
Shearing				2	H	H		X				X	
Shearing Waste	X	X	X	2	L	H		X			X		Exposure to Cut Fibers
Inspection & Roll-up		X		4	H	H		X			X		
Fiber Processing													
Application		X		30+	H	H	X				X		Direct Contact w/ FC in Spin Finish
Drawing & Texturizing	X	X	X	2	H	H		X		X	X		Possible Volatilized Residuals
Spin, Twist, & Set	X	X	X	1	H	H		X			X		Possible Dusting
Shipping Fiber		X		2	H	H		X			X		Handling Finished Goods

Point of Contact	Type of Exposure			Number of Workers (per plant)	Exposure Times		Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation		Hrs/Day <1 = Low 1-4 = Medium >4 = High	Days/Year <50 = Low 50-100 = Medium >100 = High	Liquid	Solid	Aerosol	Vapor	Open	Closed	
Sample Preparation													
Unwrapping Rolls		X	X	2	H	H		X		X	X		Possible Volatilized Residuals
Cutting, Beveling, & Surging	?	?	?	25+	H	H		X			X		Exposure to Cut Fibers
Handling		X		25+	H	H		X			X		
Retail													
Unwrapping Rolls		X	X	2	H	H		X		X	X		Possible Volatilized Residuals
Handling & Cutting		X		2	H	H		X			X		
Installation	X	X	X	1-2	H	H		X			X		Contact with Dust from the Carpet
Consumer Use		X			H	H		X			X		Direct Consumer Contact
Carpet Cleaning		X		2	M	H	X				X		Chemical in Waste Water
Reconditioning Packaging		X		2	H	H	X	X			X		Concentrated Chemical
Disposal													
Landfill													

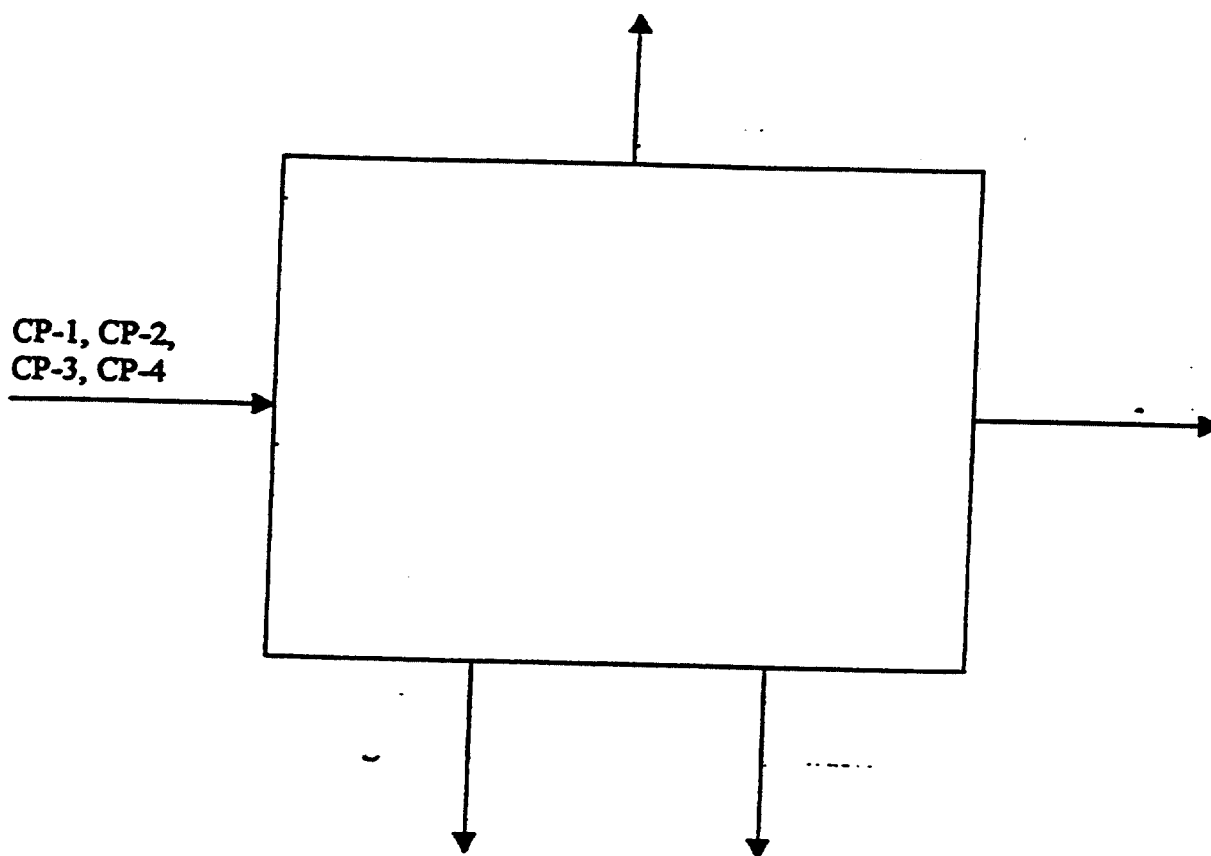
Product Flow Diagrams

These diagrams show the places that 3M fluorochemicals are introduced and lost in the life cycle of a carpet. Each application method is broken out separately in order to show greater detail. This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Product Flow Diagram



Fiber Treatments



Dilution Ratio:

Non-FC Chemicals
In Bath:

Spin Finish Oil

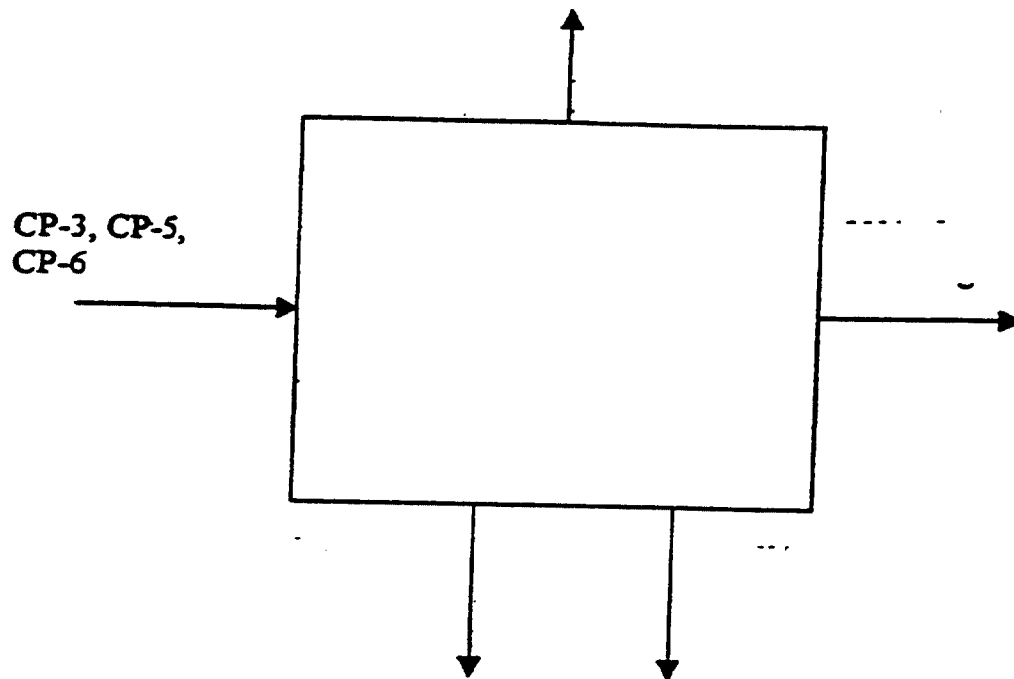
Amount of Use:

- FC fiber treatments for carpet

Exposure Routes:

Dermal

Spray Application



Dilution Ratio:

Product :

Non-FC Chemicals
In Bath:

None

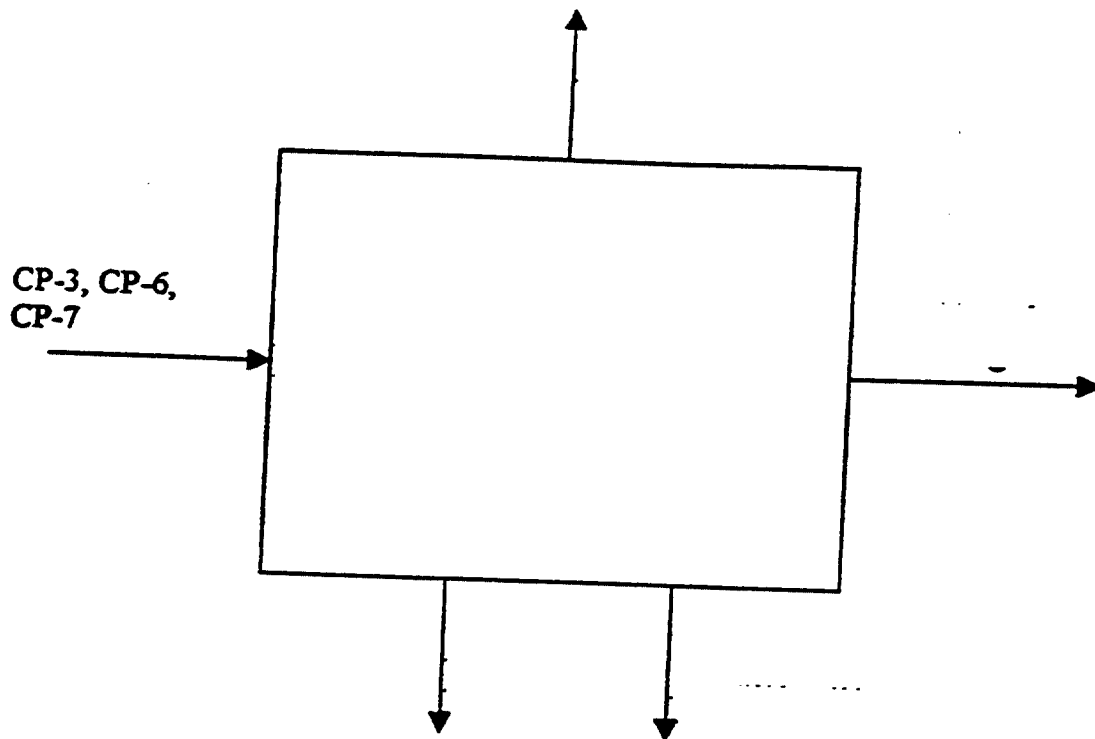
Amount of Use:

carpet treatments

Exposure Routes:

Ingestion, Dermal, Inhalation

Foam Application



Dilution Ratio:

Product : Bath

Non-FC Chemicals
In Bath:

Foaming Agent

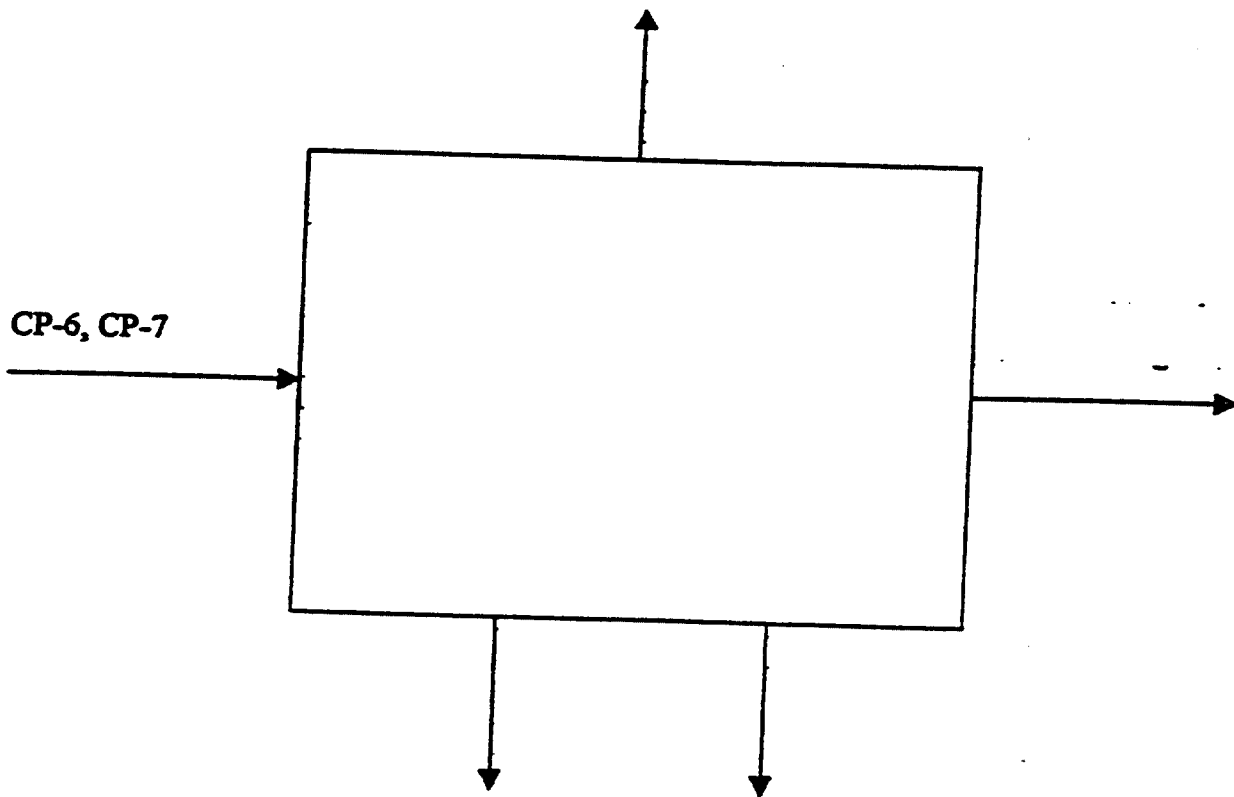
Amount of Use:

FC carpet treatments

Exposure Routes:

Dermal

Co-Application



Dilution Ratio:

Product : Bath

Non-FC Chemicals
In Bath:

Product : Bath

Amount of Use:

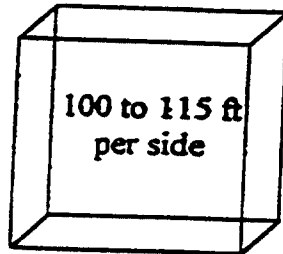
FC carpet treatments

Exposure Routes:

Dermal

Waste Disposal*

- Total carpet mill solid waste is approximately 60,000,000 lbs./year.
 - This waste includes shearing, selvages, and backed seamcuts.
 - This equals about 1 to 1.5 MM ft³ of waste per year.



- Unbacked seamcuts are typically recycled into carpet underlayment.
- Some shearing waste is being landfilled separately so that it can be recovered if a use is found for it.
- The fluorochemical portion of shearing waste is as follows:
 - Fiber Treatments (CP-3/CP-4)
 - Approximately lbs. of solids in shearing waste
 - Topical Treatments (mainly CP-6)
 - Approximately lbs. of solids in shearing waste
 - Switching from spraying and foaming to co-application would reduce this amount by up to because the treatment is evenly distributed on the fiber.
- When carpet is cleaned, the wastewater will contain OEM fluorochemical.
- The majority of the wastewater treatment burden lies on the local utilities.
- When a typical residential carpet is thrown away, it contains

* These numbers were generated internally based on customer information. These numbers are intended to be used as estimates until they can be confirmed by the industry.

End User Information

Typical Use

- The average residential carpet sees 15,000 foot traffics per year.
- Carpets are vacuumed every 1 to 2 weeks on average.
- Carpets are professionally cleaned every 3 years.

Durability

- Factors contributing to removal:
 - Temperature of the cleaning solution
 - The pH of the cleaning solution
 - The type of surfactants that are used

Lifetime of Residential Carpet

- Residential carpet is in a home for an average of 12 years.

A graph representing the removal of OEM treatments can be found on the next page.

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**Protective Chemical Products
Home Textiles Business
Fluorochemical Use, Distribution,
and Release Overview**

- **Home Furnishings, Home Fashions, Automotive**
- **Nonwovens**

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Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in the Home Textiles and Nonwoven business. It attempts to answer the following questions.

- What products are customers exposed to?
- Where does exposure happen?
- What type of exposure is it?

The 3M fluorochemical business is complex and global. Markets served are highly fragmented involving multiple 3M products that are applied to multiple substrates, sold into multiple market segments and used for multiple end products.

Sources of Information For This Report

Information for this report was developed solely from internal 3M sources. These include:

- Knowledge of product handling and use practices from field sales and technical personnel.
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- Internal sales reports
- Knowledge of worldwide activities (where applicable) by St. Paul based personnel.

How To Read This Report

The following types of information are available in this report:

Situation Analysis:

Provides background on business and products.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical throughout the distribution chain to final end user. Objective is to identify all points of contact with our chemicals – from arrival on customer's loading dock through product usage and disposal

Exposure Information Charts:

Attempts to quantify type and length of exposure and number of workers exposed to our chemicals within the distribution chain.

Product Volumes and Use Patterns:

Combines 3M product detail with the exposure routes to provide a summary of total business exposure by product type.

Home Textiles
Fluorochemical Use, Distribution and Release Overview
Table of Contents

- I. Chemical Names**
- II. Situation Analysis**
 - A. Home Furnishings, Home Fashions, Automotive**
 - 1. Business Definition
 - 2. Products and Markets
 - 3. Application Methods
 - 4. Customer Location Maps
 - B. Nonwovens**
 - A. Business Definition
 - B. Products, Markets, and Application
 - C. Customer Location Map
- III. Exposure Assessment**
 - A. Home Furnishings, Home Fashions, Automotive**
 - 1. Distribution Chain
 - 2. Points of Contact
 - 3. Exposure Routes
 - 4. Waste Stream/Recycle Characterization
 - 5. Product Volumes & Use Patterns
 - B. Nonwovens**
 - 1. Distribution Chain
 - 2. Points of Contact
 - 3. Exposure Routes
 - 4. Product Volumes & Use Patterns

Chemical Names

The following is a list of Chemical Abstract Services (CAS) names and numbers for individual products. The following information is presented:

Generic Code: Indicates an internal 3M designation of the product(s).

CAS Number: Indicates the Chemical Abstracts Services number(s) of fluorochemicals contained within each product.

Chemical Name (complete CAS name or IUPAC names if CAS name does not exist): Indicates the Chemical Abstracts Services name(s) of fluorochemicals contained within each product.

Chemical Class: Indicates a shortened, generic chemical name.

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Home Textiles			
HT-1			
HT-1, HT-2, HT-3, HT-7			
HT-2, HT-3			
HT-2, HT-3			
HT-3, HT-4, HT-7, HT-8			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
HT-3, HT-7, HT-8, HT-9			
HT-5			
HT-6			
HT-8			
HT-9			
HT-9			
HT-9			
HT-10			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Nonwovens			
NW-1			
NW-2			
NW-2			
NW-3			
NW-4			

850000 56

II. Situation Analysis

A. Home Furnishings, Home Fashions, Automotive

Business Definition

Home Furnishings – This segment is comprised of OEM customers (textiles mills and commission finishers) sharing a common need for protective treatments which impart soil and stain resistance and/or cleanability properties to upholstery fabric and other textile substrates used primarily in residential furniture. 3M protective chemicals are sold direct to the customer.

Home Fashions – This segment is comprised of OEM customers (primarily textile mills) sharing a common need for protective treatments which impart soil and stain resistance or stain release to fabrics used in home décor items such as window treatments, fabric wallcoverings, decorative pillows, slipcovers, bedspreads and comforters, mattress pads, shower curtains, and table linens. Some of these items can be laundered; others require professional cleaning.

Specification by US manufacturing companies drives OUS sales in this category.

Automotive – This market is comprised of OEM customers (textile and carpet mills) who provide protective treatments on upholstery fabrics, carpet and other textiles (headliners) used in automobile, truck, and van interiors.

U.S. Product Portfolio – Total FC Volumes

This chart outlines the products used in the Home Furnishings, Home Fashions, and Automotive markets in the U.S. The following information is provided for each product: The total fluorochemical pounds of each sold in the U.S. in 1997, and the chemical components that make up the product.

**U.S. Product Portfolio – Total FC Volumes
Home Furnishings, Home Fashions, Automotive
1997**

Product	Pounds (000)	Chemistry
HT-3		
HT-7		
HT-4		
HT-1		
HT-2		
HT-5		
HT-6		
HT-8		
Total Chemical		

U.S. Product Portfolio by Market

This chart groups the products used in the business by market segment, Home Furnishings, Home Fashions, and Automotive, and provides fluorochemical volumes sold both by product and market segment.

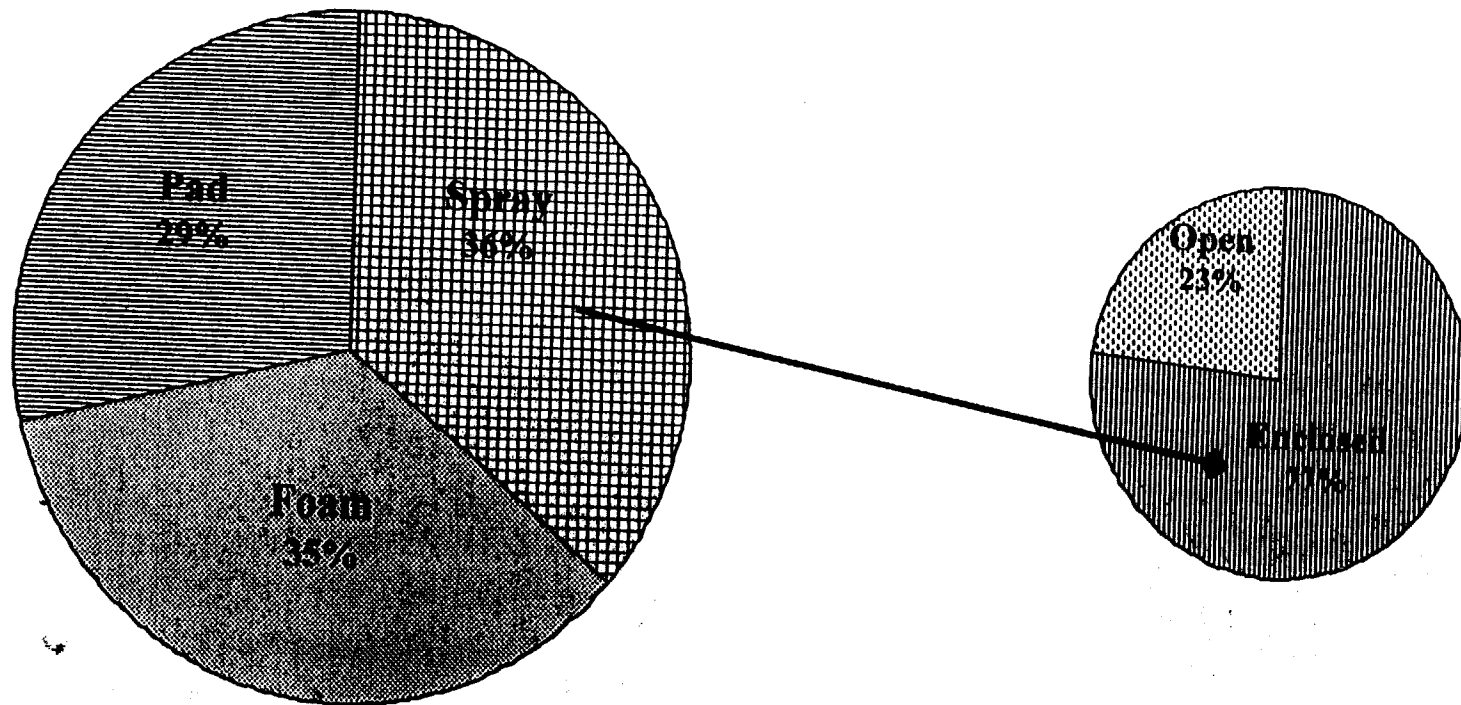
U.S. Product Portfolio by Market

Product	1997 FC Lbs. (M)
Home Furnishings	
HT-3	
HT-2	
HT-8	
HT-5	
HT-1	
Total Home Furnishings	
Home Fashions	
HT-4	
HT-2	
HT-5	
HT-3	
Total Home Fashions	
Automotive	
HT-3	
HT-7	
HT-1	
HT-6	
Total Automotive	

Application Methods
Home Furnishings, Home Fashions, and Automotive

The following chart presents the methods of applying fluorochemical in these market segments. The percentages represent the mix of these methods based on fluorochemical volumes used.

Home Furnishings, Home Fashions, Automotive Application Methods

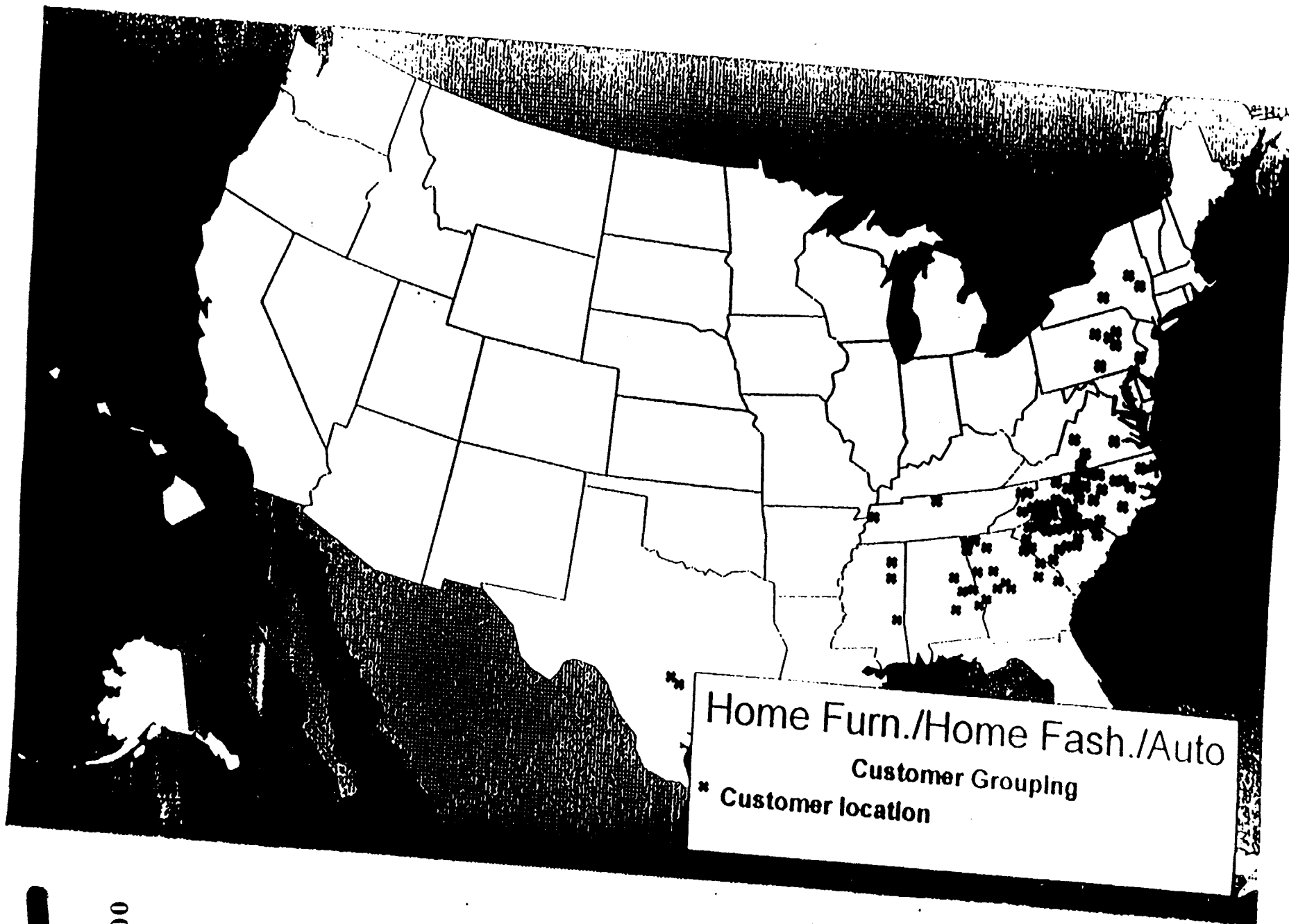


Key Customers 1997/1998

Customer Location Map

The following U.S. map identifies the location of all chemical purchasing customers in the Home Furnishings, Home Fashions, and Automotive market segments. In each case, the chemical is applied in the city indicated.





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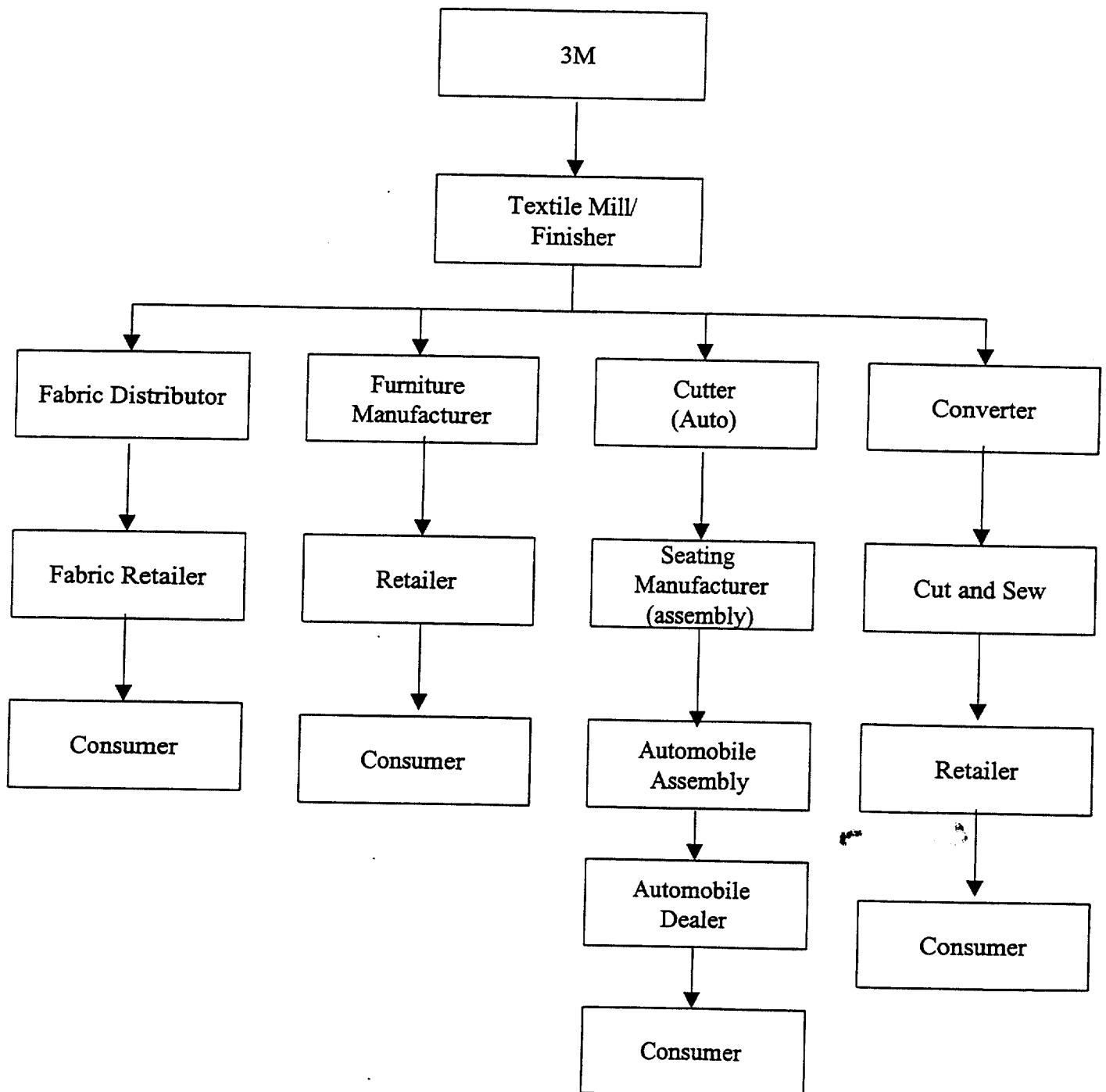
Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

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Distribution Chain

Home Furnishings, Home Fashions and Automotive



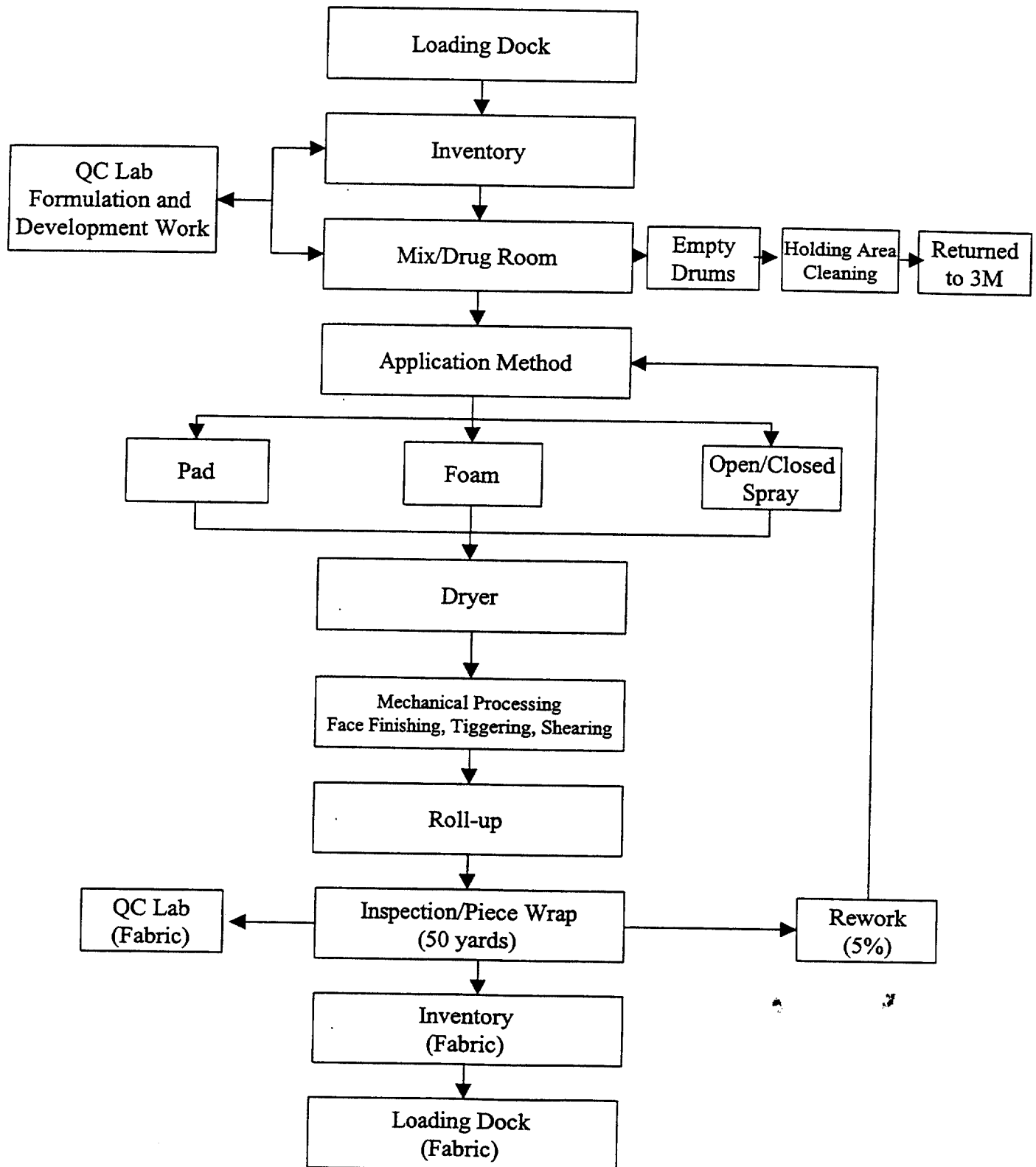
Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

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Points of Contact at Textile Mill

Home Furnishings, Home Fashions and Automotive



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information
Home Furnishings, Home Fashions and Automotive

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Loading Dock (Spills)		X		1-2	Low	X				X		Low incidence rate.
Inventory				1-2	Low	X					X	Closed system. No exposure.
Mix/Drug Room weighing, diluting		X		1-3	Medium-High	X				X		
QC Lab		X		1-3	Low	X				X		
Application - Pad, Foam		X		2-3	Medium-High	X				X		
Application - Spray - Open	X	X	X	2-4	Medium-High	X		X	X	X		
Application - Spray - Closed		X	X	2-4	Medium-High	X		X	X		X	
Spray Tip Cleaning	X	X	X	1	Low	X		X	X	X		
Drying		X	X	3-6	High	X	X			X		

Exposure Information
Home Furnishings, Home Fashions and Automotive

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Mechanical Processing (face finishing, tigging, shearing)		X	X	1-2	High		X	X		X		
Roll-up		X		1-3	High		X			X		Product dried on fabric.
Inspection/Piece Wrap		X		1-3	High		X			X		Product dried on fabric.
QC Lab (Fabric)		X		2-3	Medium		X			X		Product dried on fabric.
Inventory/Loading Dock (Fabric)				1-2	Low		X			X		Product dried on fabric.
Fabric Distributor		X		<6	Low		X			X		Product dried on fabric.
Furniture Manufacturer		X		25-50	Medium-High		X			X		Product dried on fabric.
Cutter		X	X	25-50	Medium-High		X	X		X		Product dried on fabric.
Seating Manufacturer		X		15-40	Medium-High		X			X		Product dried on fabric.

Exposure Information
Home Furnishings, Home Fashions and Automotive

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Automobile Assembly		X		15-40	Medium-High							Product dried on fabric.
Converter		X		15-20	Low		X			X		Product dried on fabric.
Cut and Sew		X		25-50	Medium-High		X			X		Product dried on fabric.
All Retailers and Consumers		X					X			X		Product dried on fabric.

III. Exposure Assessment – Home Furnishings, Home Fashions, Automotive

6. Waste Stream/Recycle Information

An approximation of the actual disposition of the chemical after it arrives at a customer site is given below. No exact values are known.

<u>Chemical State</u>	<u>Attributable Cause for Loss</u>	<u>High Reasonable Estimate</u>
As shipped	Residual in shipping drums	
As shipped	Spills	
Dilute mix	Unused pad/foam mix	
Dilute mix	Non-recovered spray • Coating on equipment • Overspray • Vented material	
Dilute mix	Start up and shut down excess	
Dried on fabric	Shearing and face finishing	
Dried on fabric	Unrecoverable, off-quality fabric	
Dried on fabric	Seam cut-outs	
Dried on fabric	Quality/SQC samples	



Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns
Global Product Portfolio
Home Furnishings, Home Fashions and Automotive

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
HT-3	Application					X			X	X	X			X	
HT-3	End Use						X	X	X			X			
HT-7	Application					X			X	X	X			X	
HT-7	End Use						X	X	X			X			

Product Volumes and Use Patterns
Global Product Portfolio
Home Furnishings, Home Fashions and Automotive

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
HT-4	Application					X			X					X	Foam or pad applied.
HT-4	End Use						X	X	X			X	X		
HT-1	Application					X			X					X	
HT-1	End Use							X	X			X			

Product Volumes and Use Patterns
Global Product Portfolio
Home Furnishings, Home Fashions and Automotive

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
HT-2	Application					X			X					X	
HT-2	End Use							X	X			X	X		
HT-5	Application					X			X	X	X			X	Spray applied
HT-5	End Use							X	X			X	X		

Product Volumes and Use Patterns
Global Product Portfolio
Home Furnishings, Home Fashions and Automotive

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
HT-6	Application					X			X					X	
HT-6	End Use						X	X	X			X	X		

Product Volumes and Use Patterns
Global Product Portfolio
Home Furnishings, Home Fashions and Automotive

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
HT-8						X			X					X	Foam applied.
HT-8								X	X			X	X		
HT-10							X		X	X	X			X	
HT-10								X	X			X	X		

II. Situation Analysis

B. Nonwovens

Business Definition

Nonwovens – This market is comprised of OEM customers (nonwoven plants, finishers) sharing a common need for oil and water resistance. Additionally, master batch producers process our polymer melt product into a form that is more readily handled by extrusion processes at selected nonwoven mills. The fabrics produced are used as medical fabrics (surgical gowns, drapes and wraps) as well as industrial materials, primarily filter media. 3M protective chemicals are sold direct to the customer.

Key Products – Nonwovens

This chart outlines the products used in the Nonwovens market in the U.S. Included in the chart of the total fluorochemical volumes sold to each of nine key customers, the application method these customers used to apply the chemical, and intended end use of the treated goods.



Key Products Nonwovens

Product	Total '97 (000 FC lbs.)	Estimate '98 (000 FC lbs.)	Application	End Use
NW-1			Pad	Medical Fabric
NW-3			Pad	Filter Media
NW-2			Pad	Disposable Workwear
NW-3			Pad	Filter Media
NW-4			Extrusion	Compound
NW-4			Extrusion	Medical Fabrics
NW-3			Pad	Medical Fabrics
NW-4			Extrusion	Concentrate
NW-4			Extrusion	Outdoor Furniture



Customer Location Map

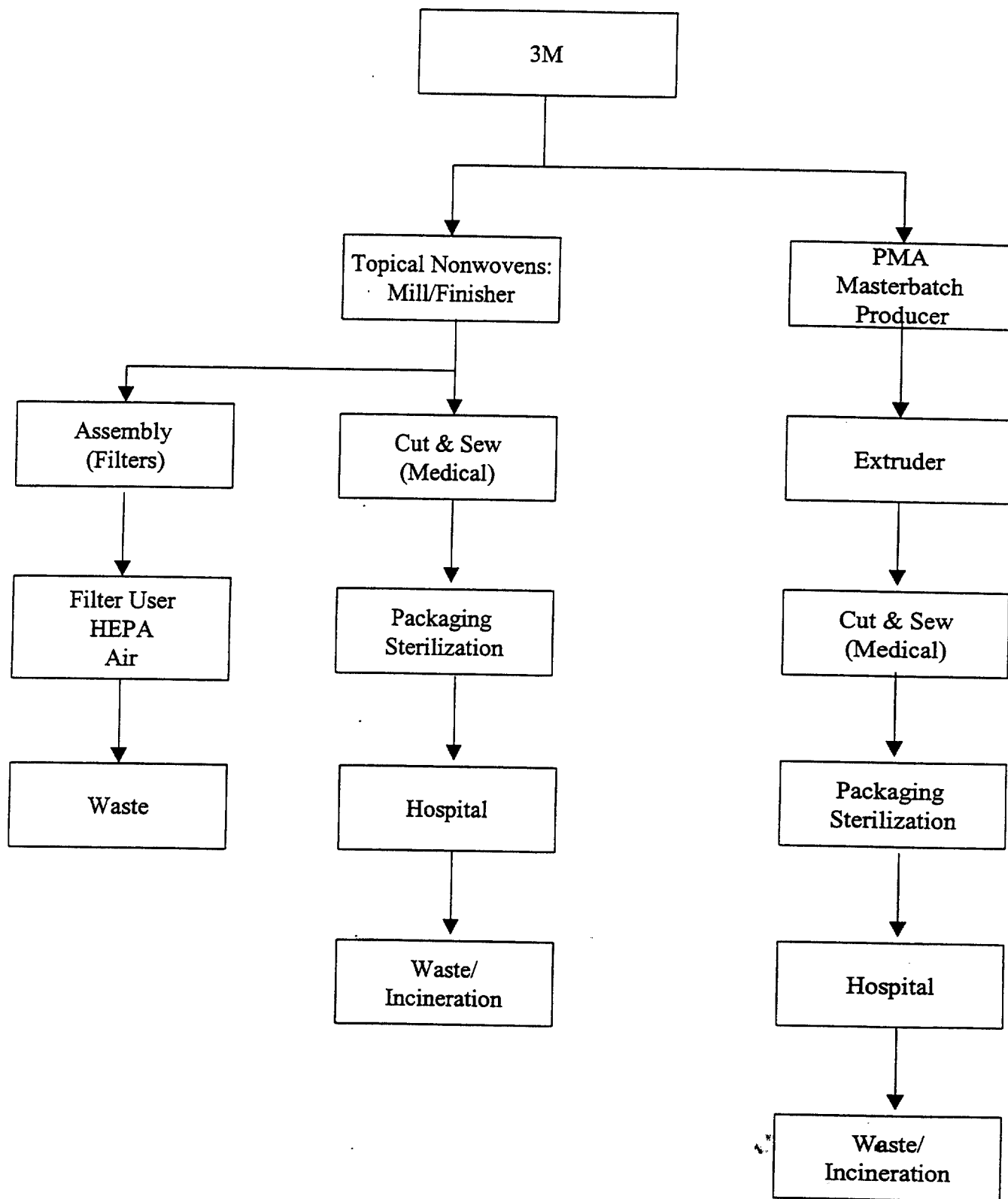
The following U.S. map identifies the location of all chemical purchasing customers in the Nonwovens market segment. In each case, the chemical is applied in the city indicated.



Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

Nonwovens Distribution Chain

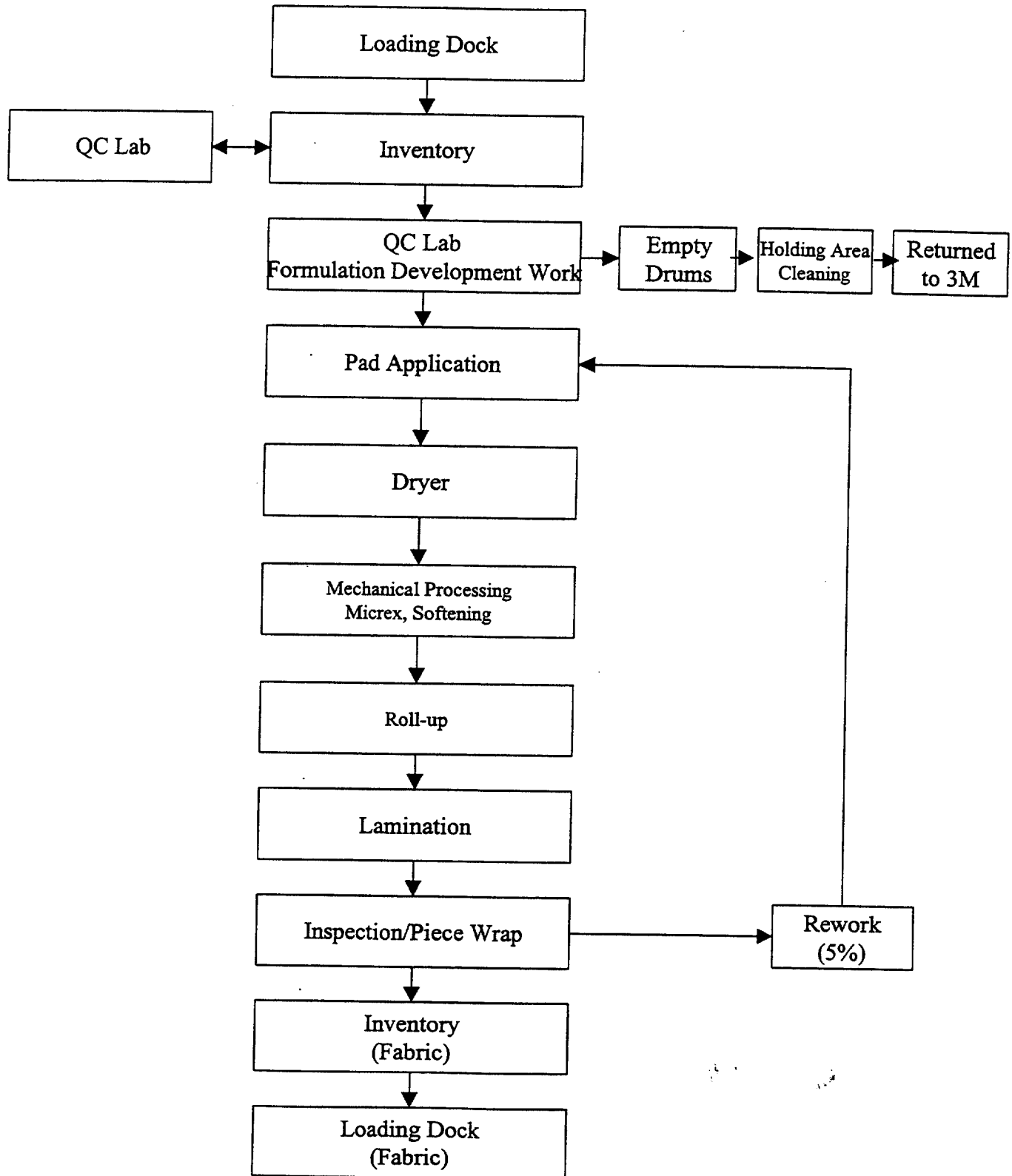


Points of Contact

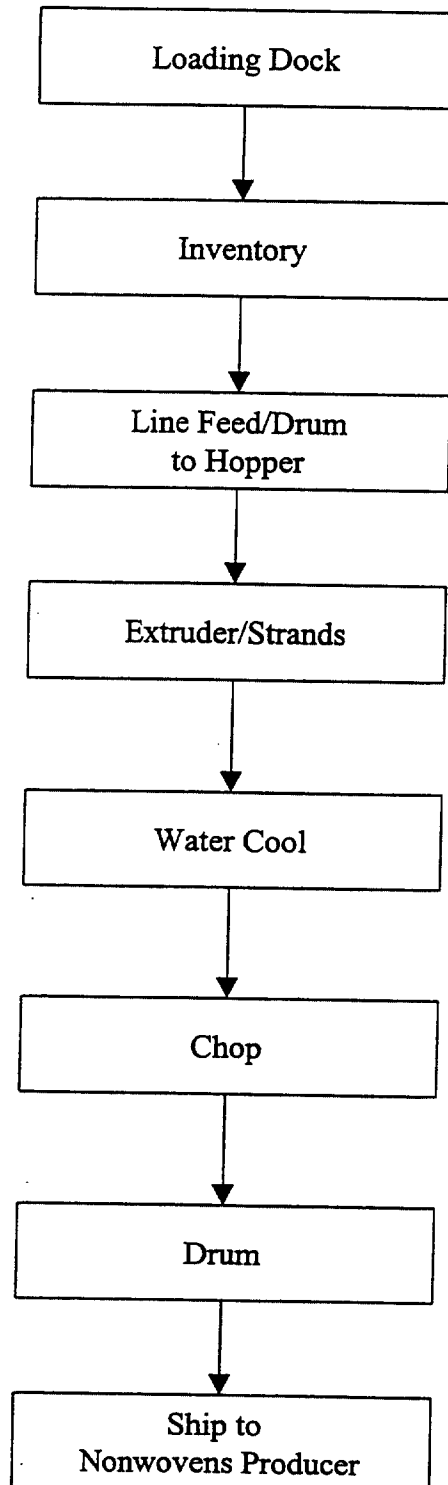
The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.



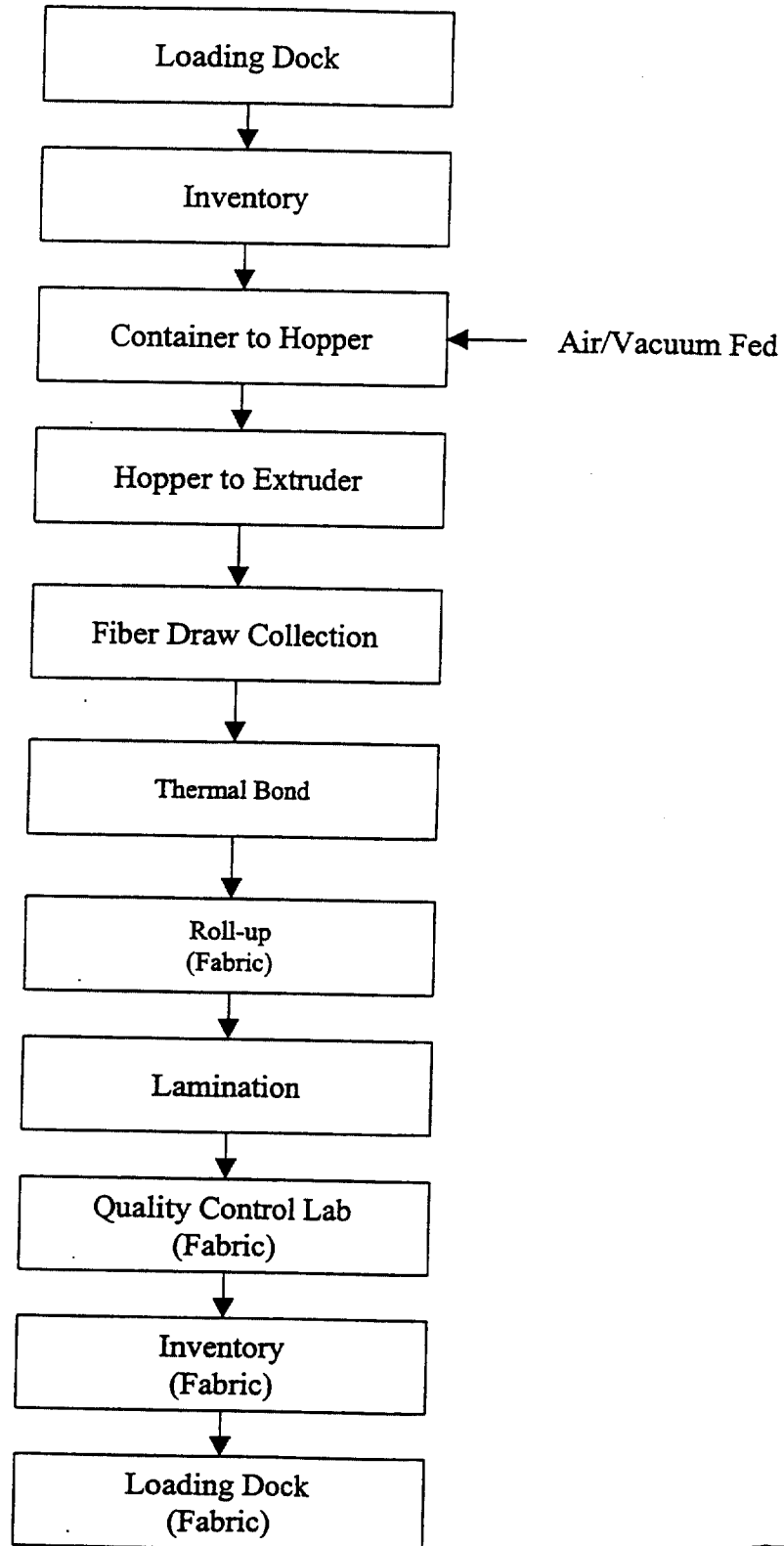
Points of Contact - Mill Topical Nonwovens



Points of Contact - Masterbatch Producer Nonwovens PMA



Points of Contact - Extruder Nonwovens PMA



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information
Nonwovens

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation	(per plant)		Liquid	Solid	Aerosol	Vapor	Open	Closed	
Mill - Pad Application												
Loading Dock (Spills)		X		1-2	Low	X				X		Low incidence rate.
Inventory				1-2	Low	X					X	Closed system. No exposure.
QC Lab		X		1-3	Low	X				X		
Pad Application		X		2-3	Medium-High	X				X		
Drying			X	3-6	High		X				X	
Mechanical Processing (Micrex, softening)	X		X	1-2	Medium		X	X		X		
Roll-up		X		1-3	High		X			X		Product dried on fabric.
Lamination		X	X	2-3	Medium		X			X		Product dried on fabric.
Inspection/Piece Wrap				2-3	Low		X			X		Product dried on fabric.
Inventory/Loading Dock (Fabric)				1-2	Low		X			X		Product dried on fabric.

Exposure Information
Nonwovens

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Masterbatch Producer												
Loading Dock (Spills)		X		1-2	Low		X			X		Product is flake.
Inventory				2-3	Low		X			X		Product is flake.
Line Feed/Drum to Hopper		X	X	2-3	Medium		X			X		Product is flake, potential for dust.
Extruder/Strands			X	2-3	Medium		X		X	X		
Water Cool				2-3	Medium		X			X		
Chop			X	2-3	Medium		X			X		
Drum		X	X	2-3	Medium		X			X		
Ship to Nonwovens Producer		X					X			X		

**Exposure Information
Nonwovens**

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Extruder												
Loading Dock (Spills)		X		2-3	Low		X			X		
Inventory				1-2	Low		X				X	
Container to Hopper				1-2	Medium		X				X	
Hopper to Extruder				1-2	Medium		X				X	
Fiber Draw Collection			X	2-3	Medium		X		X	X		
Thermal Bond			X	2-3	Medium		X		X		X	
Roll-up (Fabric)		X		2-3	Medium		X				X	
Lamination		X	X	2-3	Medium		X			X		
QC Lab (Fabric)		X		2-3	Low		X			X		

**Exposure Information
Nonwovens**

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Inventory/Loading Dock (Fabric)				2-3	Low		X			X		
Downstream Processing of Roll Goods												
Assembly (Filters)		X	X	3-5	Low		X			X		Product dried on nonwoven.
Cut and Sew (Medical)		X	X	15-20	High		X			X		Product dried on or incorporated into nonwoven.
Packaging Sterilization		X		3-5	High		X			X		Product dried on or incorporated into nonwoven.
All End Users		X					X			X		Product dried on or incorporated into nonwoven.

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns
Global Product Portfolio Nonwovens

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
NW-1	Application					X			X					X	
NW-1	End Use						X	X	X			X	X		
NW-3	Application					X			X					X	Pad applied
NW-3	End Use						X		X			X	X		

Product Volumes and Use Patterns
Global Product Portfolio Nonwovens

Product Code	Application Process or End Use	Volume Sold 1997 (lbs product)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
NW-2	Application					X			X					X	Pad applied
NW-2	End Use						X	X	X			X	X		
NW-4	Application					X			X	X		X	X	X	
NW-4	End Use						X	X	X			X	X		

**Protective Chemical Products
Apparel and Leather Business
Fluorochemical Use, Distribution,
and Release Overview**

Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in the Apparel and Leather business. It attempts to answer the following questions.

- What products are customers exposed to?
- Where does exposure happen?
- What type of exposure is it?

The 3M fluorochemical business is complex and global. Markets served are highly fragmented involving multiple 3M products that are applied to multiple substrates, sold into multiple market segments and used for multiple end products.

This report includes global information based largely on the knowledge of worldwide activities by St. Paul-based personnel.

Sources of Information For This Report

Information for this report was developed solely from internal 3M sources. These include:

- Knowledge of product handling and use practices from field sales and technical personnel
- Best estimates of end-use applications from known customer activities.
- Internal sales reports showing regional sales breakdowns for apparel and leather products.

How To Read This Report

The following types of information are available in this report:

Situation Analysis:

Provides background on business and products. Helpful to understand Apparel and Leather customer base, global scope and diversity of markets.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical throughout the distribution chain to final end user. Objective is to identify all points of contact with our chemicals – from arrival on customer's loading dock

Exposure Information Charts:

Attempts to quantify type and length of exposure and number of workers exposed to our chemicals within the distribution chain.

Product Volumes and Use Patterns:

Combines 3M product detail with the exposure routes to provide a summary of total business exposure by product type.

**Apparel and Leather
Fluorochemical Use, Distribution
And Release Overview
Table of Contents**

I. Chemical Names

II. Situation Analysis

- A. Business Definition
- B. Global Polymers
- C. Key Markets and End Uses
- D. Application Methods
- E. Customer Location Maps

III. Exposure Information - Apparel

- A. Distribution Chain
- B. Points of Contact
- C. 3M Fluorochemical Exposure Information
- D. Waste Stream/Recycle Characterization
- E. Product Volumes and Use Patterns

IV. Exposure Information – Leather

- A. Distribution Chain
- B. Points of Contact
- C. 3M Fluorochemical Exposure Information
- D. Waste Stream/Recycle Characterization
- E. Product Volumes and Use Patterns

Chemical Names

The following is a list of Chemical Abstract Services (CAS) names and numbers for individual products. The following information is presented:

Generic Code: Indicates an internal 3M designation of the product(s).

CAS Number: Indicates the Chemical Abstracts Services number(s) of fluorochemicals contained within each product.

Chemical Name (complete CAS name or IUPAC names if CAS name does not exist):
Indicates the Chemical Abstracts Services name(s) of fluorochemicals contained within each product.

Chemical Class: Indicates a shortened, generic chemical name.

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Apparel			
AP-1, AP-5			
AP-1, AP-5			
AP-1, AP-5			
AP-2			
AP-3			
AP-3			
AP-3			
AP-4, AP-5			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
AP-6			
AP-7			
AP-8			
AP-9			
Leather			
FO-1			
FO-2, FO-3, FO-4			
FO-5, LE-3			
FO-6			
FO-7			
FO-7			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
FO-7			
FO-7			
FO-7			
FO-8			
LE-1			
LE-2			
LE-4			

Apparel and Leather Fluorochemical Use, Distribution, and Release Overview

II. Situation Analysis

A. Business Definition

Sale of fluorochemicals for application on fabrics and leather used to manufacture garments, footwear, accessories and other non-garment functional fabrics.

Direct Customers:

- Textile Mills/Commission Finishers that use fluorochemicals to provide oil and water repellency to enhance the functional performance of the fabric produced.
- Leather Tanneries/Finishers that use fluorochemicals to enhance functional performance as above and/or serve as a processing aid in the conversion of raw leather.
- Chemical Formulators that use fluorochemicals as ingredients for the textile and leather care, dry clean and fatliquor industries.
- Chemical Distributors that resell products to end users and may do quality testing repackaging and/or lab tech service work.

Global Business Size:

Global Polymers

This chart outlines the nine polymers used in the Apparel and Leather Markets product portfolio which features 19 different products. The polymers are divided into major product categories: Repellent, Stain Release, Leather and Formulators.

The following information is provided for each polymer: the chemical components that make up the polymer, and the total fluorochemical pounds sold in 1997 for each. Volume information is provided relative to the other polymers in the product category, and relative to the total pounds sold in the Apparel and Leather Markets. The geographic breakout, US vs. outside the US is also provided.

Global Polymers (000)

Chemistry		Polymers					
		AP-1					
		AP-4					
		AP-9					
		AP-7					
		AP-6					
		AP-5					
Sub-Total:							
		AP-8					
		AP-2					
		LE-4					
		LE-2					
		LE-1					
		LE-3					
Sub-Total:							
		FO-8					
		FO-4, FO-7					
		FO-6					
		FO-7					
		FO-5					
		FO-1					
		FO-2					
		FO-3					
Sub-Total:							
Total							

C. Major Markets and End Uses

This chart provides detail about the major markets that each of the four Apparel and Leather product lines goes to. This includes typical end uses and the major substrate types where 3M fluorochemicals are used. Information about relative size of the 3M product lines is also shown.

This information was developed using the market knowledge of 3M employees involved with these products.

Apparel and Leather
Fluorochemical Use, Distribution, and Release Overview
Major Markets and End Uses

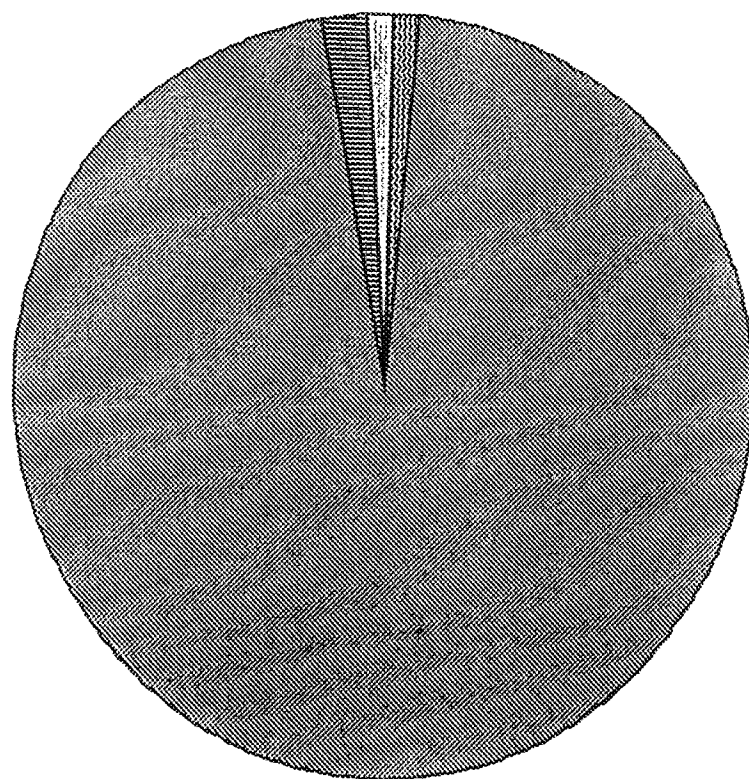
Product Line	Estimated Volume		Market	End Use	Typical Substrate
	lbs	% of Total			
			outerwear activewear dress clothing uniforms technical textiles other	raincoats skiwear, golfwear suits, slacks jackets, slacks awnings, boat covers, protective clothing tents, backpacks, etc.	poly / cotton polyester, nylon wool, poly/wool wool, poly/wool acrylics, poly/cottons, other nylon, polyester, other
			uniforms workwear casual clothing dress clothing	shirts, pants, jackets shirts, pants shirts, pants shirts	cotton, poly/cotton cotton, poly/cotton cotton, poly/cotton cotton, poly/cotton
			footwear garment accessories upholstery	shoes, boots leather jackets, gloves, handbags, etc. chairs, sofas, etc.	pigskin, bovine pigskin, bovine, sheep, goat bovine, deer sheep
			textile & leather care dry cleaners fatliquor supplies	aerosols, shoe creams, polishes rainwear/outerwear waterproof leather	

D. Application Methods - Apparel Fabrics

The following chart presents the methods of applying fluorochemical in this market segment. The percentages represent the mix of these methods based on fluorochemical volumes used.



Apparel Mill FC Application Methods



- Exhaust on Yarn - <1%
- Foam - 2%
- Coating - 1%
- Pad - 96%

Apparel and Leather Team Estimates

D. Application Methods - Leather Tanneries

The following chart presents the methods of applying fluorochemical in this market segment. The percentages represent the mix of these methods based on fluorochemical volumes used.

000118



III. Exposure Information - Apparel

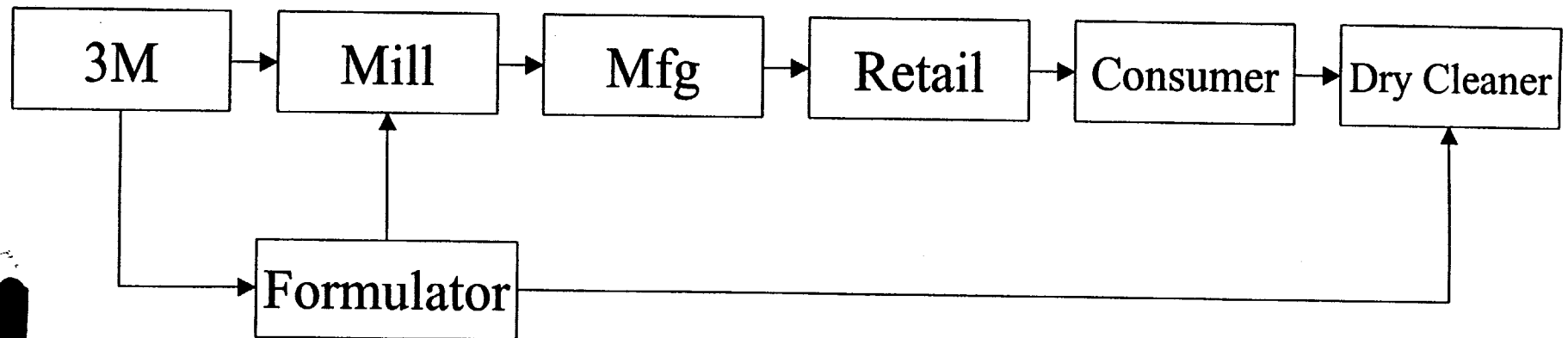
000123 

A. Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

Distribution Chain

Apparel

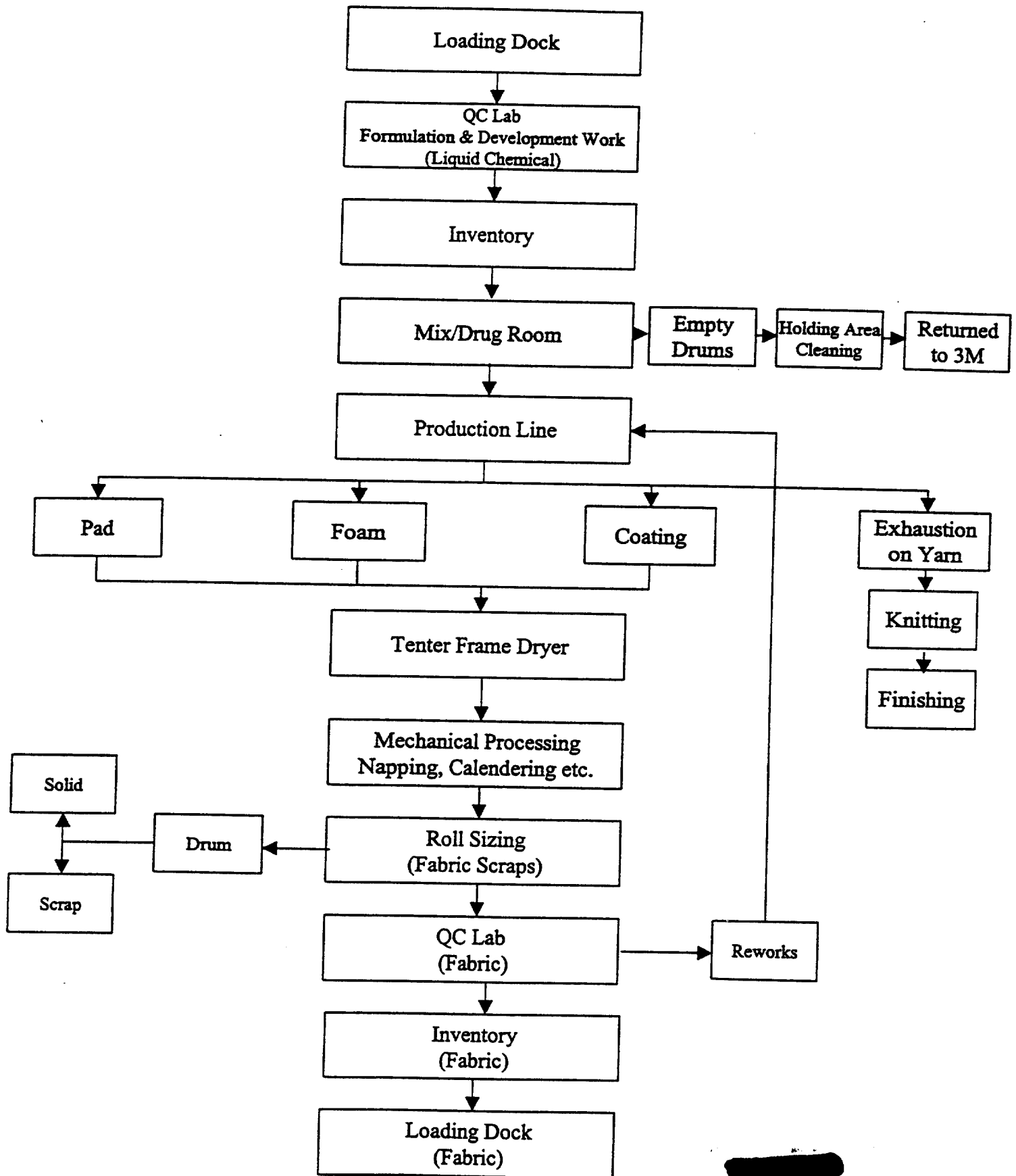


000125

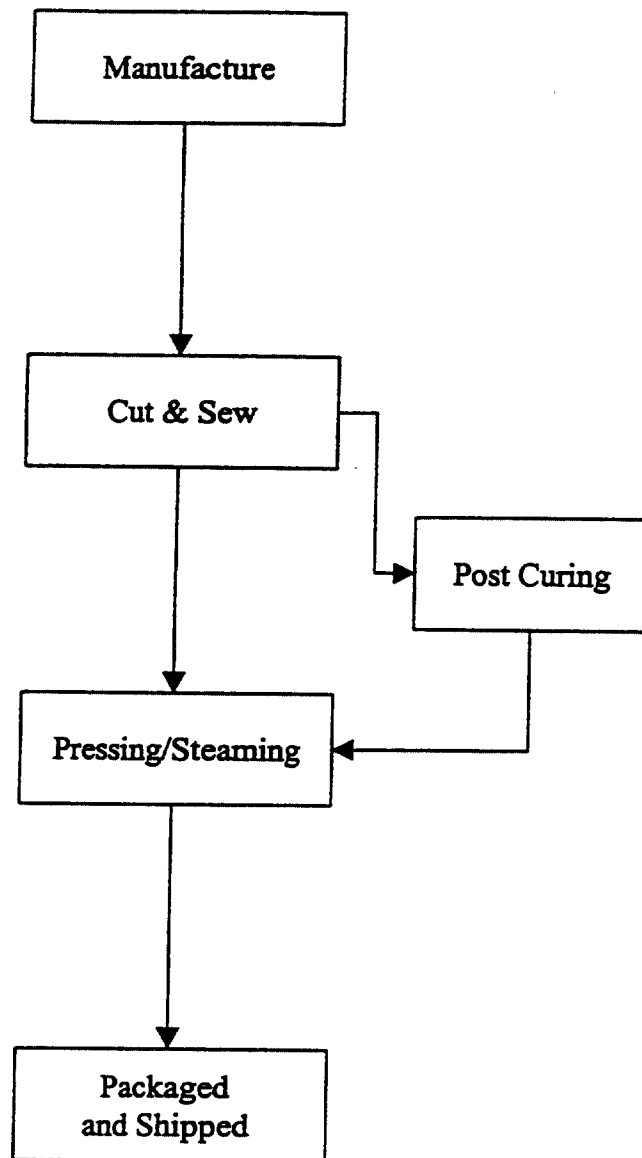
B. Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

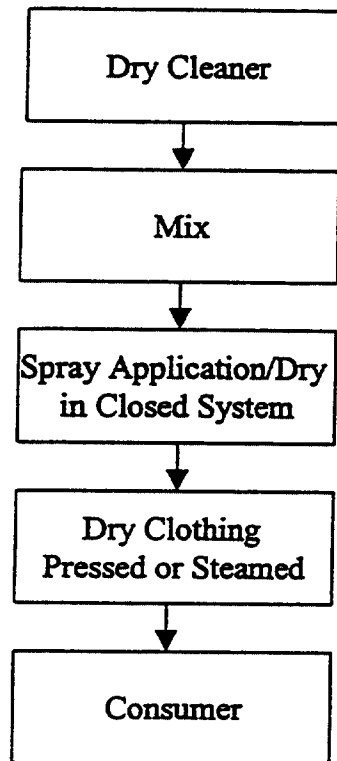
Points of Contact at Textile Mill Apparel



Points of Contact at Manufacture Apparel



Points of Contact at Dry Cleaner Apparel




000130

C. 3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during use.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information
Apparel

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation	(per plant)		Liquid	Solid	Aerosol	Vapor	Open	Closed	
Textile Mill												
Loading Dock (Spills)		X		1	Low	X				X		Low incidence Rate.
QC Lab Formulation & Development Work		X		1-2	Low	X	X			X		
Inventory (Chemical)				1	Low	X					X	Closed system no/very little potential exposure.
Mix/Drug Room		X		1-3	High	X				X		
Application - Pad, Foam, Coating		X	X	1-3	High	X				X		
Exhaustion on Yarn		X	X	1 per machine 2 at oven	High	X		X		X		
Knitting		X		1-2	High		X			X		Product dried on yarn.
Finishing		X		1-2	High		X			X		Product dried on yarn.
Drying/Roll-up		X	X	1-3	High		X		X	X		

130

000132

**Exposure Information
Apparel**

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Mechanical Finishing (napping, calandering etc.)		X	X	2 per machine How many machines?	High		X	X		X		
Roll Sizing		X		1 per machine	High		X			X		
QC Lab (Fabric)		X		1-2	Low		X			X		
Inventory (Fabric)				1	Low		X			X		
Loading Dock (Fabric)				1	Low		X			X		
Garment Manufacture - Pretreated												
Create Garment		X		>25	High		X	X		X		
Post Curing				1-3	Low		X		X	X		
Pressing/Steaming		X	X	>25	Low		X		X	X		
Packaging and Shipping		X		3-5	Low		X			X		

**Exposure Information
Apparel**

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50- 100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Dry Cleaners												
Mix		X		1-2	Medium	X				X		
Spray Application Closed				1-2	Medium	X		X			X	No/very little potential exposure - closed system.
Pressing/Steaming of Dry Clothing		X	X	1-2	Medium		X		X	X		
Consumer												
Consumer		X					X			X		Product dried on fabric

D. Waste Stream/Recycle Information – Apparel

An approximation of the actual disposition of the chemical after it arrives at a customer site is given below. No exact values are known.

**Waste chemical in liquid form
as received that ends up in
the sewer:**

Apparel

e.g.

Product adhering to inside of drum

Spills

Unused application mix

Miscellaneous

**Percent of chemical poundage sold that
ends up on waste yardage of fabric/leather:**

e.g.

Second quality fabric/leather

Color samples

Lab samples

Cutting scraps that are recycled or landfilled

**Total percent of chemical poundage sold that
ends up as waste or on waste goods:**

000135

E. Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns
Global Product Portfolio
Apparel

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluoro-chemical)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
AP-8	Application					X			X					X	X	Pad applied
AP-8	End Use						X	X	X		X	X	X			
AP-1	Application					X			X					X	X	Pad applied
AP-1	End Use							X	X			X	X			

Product Volumes and Use Patterns
Global Product Portfolio

Apparel

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluoro-chemical)	Chemistry	Estimated % Residuals	Use Pattern			Most Likely Route of Exposure			Environmental Fate				Comments
AP-2	Application					X		X					X		Pad applied
AP-2	End Use						X	X	X		X	X			
FO-2	Application						X		X		X	X			
FO-2	End Use							X	X		X	X			

Product Volumes and Use Patterns
Global Product Portfolio
Apparel

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluoro-chemical)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
AP-3	Application					X			X					X		Pad applied
AP-3	End Use							X	X			X	X			
AP-4	Application					X			X					X	X	
AP-4	End Use						X	X	X			X	X			
AP-5	Application					X			X					X	X	
AP-5	End Use						X	X	X			X	X			

Product Volumes and Use Patterns
Global Product Portfolio
Apparel

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluoro-chemical)	Chemistry	Estimated % Residuals	Use Pattern			Most Likely Route of Exposure			Environmental Fate				Comments
AP-6	Application					X			X				X		Pad applied
AP-6	End Use						X	X	X			X	X		
AP-7	Application					X			X					X	
AP-7	End Use							X	X			X	X		

IV. Exposure Information - Leather

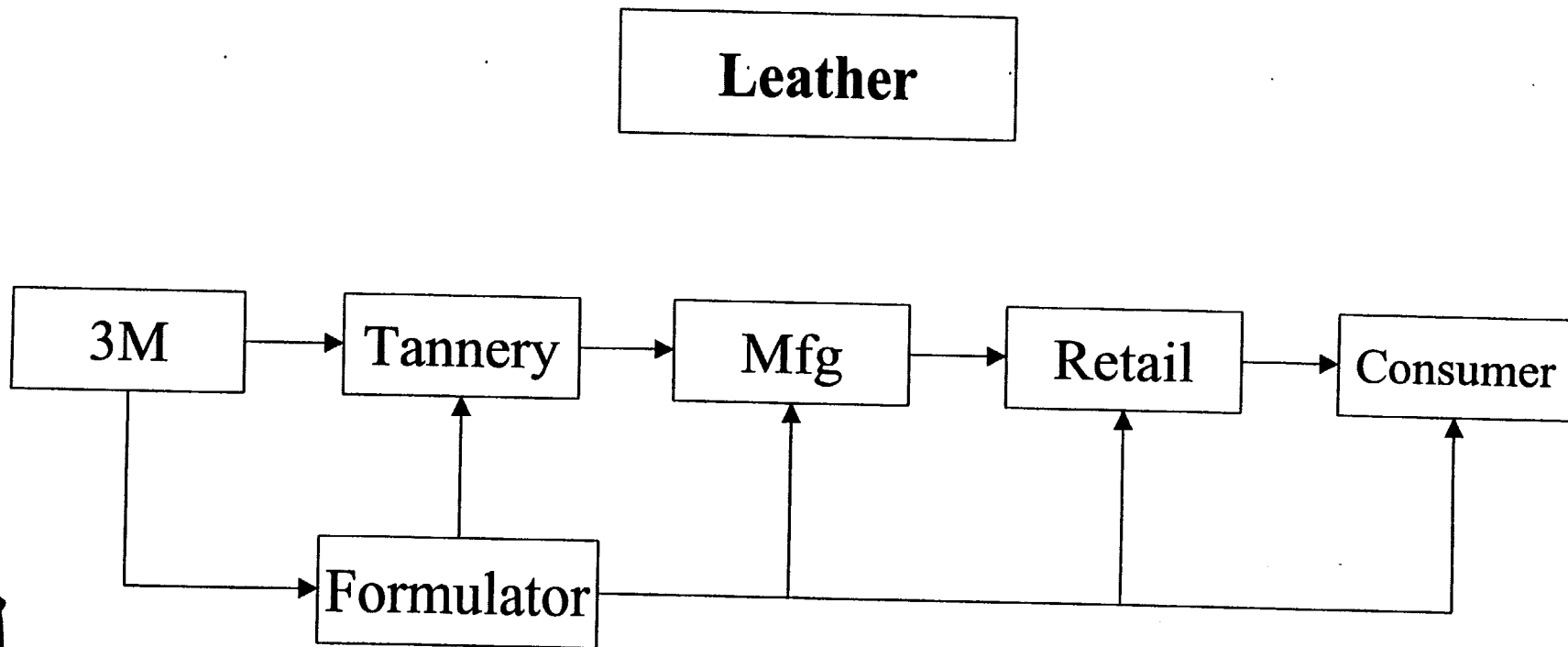
000141 

A. Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

000142

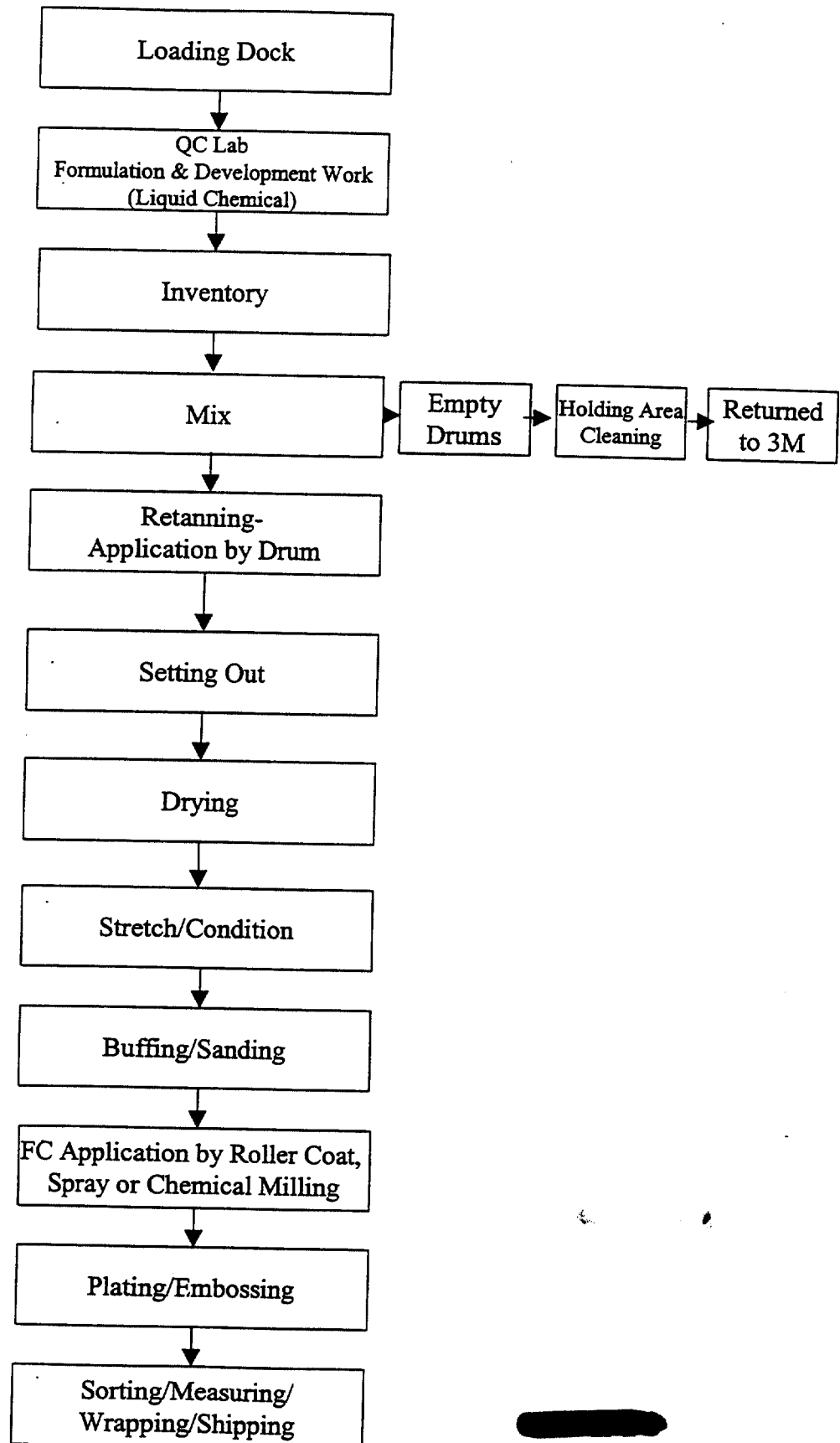
Distribution Chain



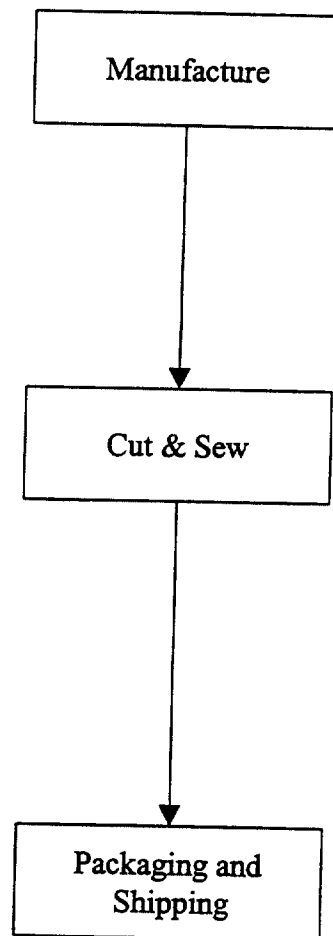
B. Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

Points of Contact at Tannery Leather



Points of Contact at Manufacture Leather



000146

C. 3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information
Leather

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation	(per plant)		Liquid	Solid	Aerosol	Vapor	Open	Closed	
Leather Tannery												
Loading Dock (Spills)		X		1-2	Low	X				X		Low incidence Rate.
QC Lab Formulation & Development Work		X		1-2	Low	X				X		
Inventory (Chemical)				1-2	Low	X					X	Closed system no/very little potential exposure.
Mix		X		1-2	Medium-High	X				X		
Retanning - Application by Drum		X	X	1-2	Medium-High	X	X		X	X		
Setting Out		X		1-2	Medium-High	X				X		
Drying		X	X	1-2	Medium-High		X		X	X		
Stretch/Condition		X		1-2	Medium-High		X			X		

Exposure Information
Leather

Point of Contact	Most Likely Route of Exposure			Estimated Number of Workers (per plant)	Estimated Exposure Time <1hr/day for <50days/year = Low 1-4hrs/day for 50-100days/yr = Medium >4hrs/day for >100days/yr = High	Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Buffing/Sanding		X	X	1-2	Medium-High		X	X		X		
FC Application by Roller Coat, Spray or Chemical Milling		X		1-2	Medium-High	X				X	X	Semi-closed spray application
Plating/Embossing		X	X	1-2	Medium-High		X		X	X		
Sorting/Measuring/Wrapping/Shipping		X		1-2	Medium-High		X			X		
Garment, Accessory, Shoe or Upholstery Manufacture												
Cut and Sew		X	X		Medium-High		X	X		X		
Packaging/Wrapping and Shipping		X			Medium-High		X			X		
All Retailers and Consumers		X					X			X		Product dried on leather

D. Waste Stream/Recycle Information – Leather

An approximation of the actual disposition of the chemical after it arrives at a customer site is given below. No exact values are known.

**Waste chemical in liquid form
as received that ends up in
the sewer:**

Leather

e.g.

Product adhering to inside of drum

Spills

Unused application mix

Miscellaneous

**Percent of chemical poundage sold that
ends up on waste yardage of fabric/leather:**

e.g.

Second quality fabric/leather

Color samples

Lab samples

Cutting scraps that are recycled or landfilled

**Total percent of chemical poundage sold that
ends up as waste or on waste goods:**

E. Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns
Global Product Portfolio
Leather

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluorochemical)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
LE-4	Application					X			X	X	X			X	Primary application is by drum, material may be roll or spray applied in a closed system.
LE-4	End Use						X	X	X			X	X		
LE-2	Application					X			X	X	X			X	Primary application is by spray.
LE-2	End Use						X	X	X			X	X		
LE-1	Application					X								X	
LE-1	End Use						X	X	X			X	X		
LE-3	Application					X								X	
LE-3	End Use						X	X	X			X	X		

Product Volumes and Use Patterns
Global Product Portfolio
Leather

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluorochemical)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
FO-4	Process					X			X					X	
FO-4	End Use							X	X	X	X	X	X		

Product Volumes and Use Patterns
Global Product Portfolio
Leather

Product Code	Application Process or End Use	Volume Sold 1997 (lbs fluoro-chemical)	Chemistry	Estimated % Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate			Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	
FO-5	Process					X			X					X	
FO-5	End Use							X	X	X	X	X	X		
FO-8	Process					X			X					X	
FO-8	End Use							X	X	X	X	X	X		
FO-6	Process					X			X					X	
FO-6	End Use							X	X	X	X	X	X		

**3M Aftermarket Application
and Retail Consumer Business**

**FLUOROCHEMICAL USE, DISTRIBUTION
AND RELEASE OVERVIEW**

RETAIL MARKETS PRODUCTS

COMMERCIAL MARKETS PRODUCTS

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Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in the Aftermarket Application and Retail Consumer businesses. It attempts to answer the following questions:

- ◆ What products are customers exposed to?
- ◆ Where does exposure happen?
- ◆ What type of exposure is it?

Use of 3M fluorochemicals in the Aftermarket Application and Retail Consumer markets is complex and global. Markets served are highly fragmented and involve a number of 3M fluorochemical products that are used as ingredients in end-use 3M formulations. The 3M formulations are used by 3M customers to treat various substrates such as carpets, floors, upholstery, apparel.

Sources

Information for this report was developed solely from internal 3M sources. These include:

- ◆ Knowledge of product handling and use practices from field sales and technical personnel
- ◆ Best estimates of end-use applications from known customer activities.
- ◆ Internal sales reports
- ◆ Knowledge of worldwide activities (where applicable) by St Paul-based personnel

How To Read This Report

Situation Analysis:

Provides background on business and products.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical in a 3M end-use product from the manufacturing process, where applicable, through the distribution chain to final end user and its end use mode. Objective is to identify all significant points of contact with 3M fluorochemicals – from arrival on customer's loading dock through product usage and disposal.

Exposure Information:

Attempts to quantify type and length of exposure and number of workers exposed to 3M fluorochemicals within the distribution chain.

Product Volumes and Use Patterns:

Combines 3M product detail with the exposure routes to provide a summary of total business exposure by product type.

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Retail Market Products

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Fluorochemical Identities Chart

Situation Analysis

Distribution Chain &
Points of Contact

FC Exposure Information Summary

FC Exposure Information Charts

Product Volumes &
Use Patterns Summary

Product Volumes &
Use Patterns Chart

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**FLUOROCHEMICAL IDENTITIES CHART
RETAIL MARKETS PRODUCTS**

GENERIC CODE	CAS NUMBER	CAS NAME	FC CHEMISTRY NAME
HC-1, HC-2, HC-3, AA-1, AA-2			
HC-4			
HC-5, AA-3			

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RETAIL MARKET PRODUCTS

Situation Analysis

BUSINESS DEFINITION

Home treatment of upholstery, carpet, auto interiors and apparel by individual retail consumers.

KEY PRODUCTS

Aerosol can spray cleaners and protectors for home use – cleaners for fabric, upholstery, carpet; protectors for fabric, upholstery, carpet, leather. All products in this category are manufactured by independent, non-3M manufacturing facilities under contract with 3M.

KEY MARKETS

Grocery, club, hardware, auto parts stores.

KEY CUSTOMERS

Individual retail consumers.

INTENDED USE

Occasional home use on carpets, upholstery, apparel, auto interiors, shoes and boots.

EXPECTED USE

Home use. Fabric protector -- two cans per year per product user. Other products – one can or less per year per product user.

Retail Markets Products

Distribution Chain and Points of Contact

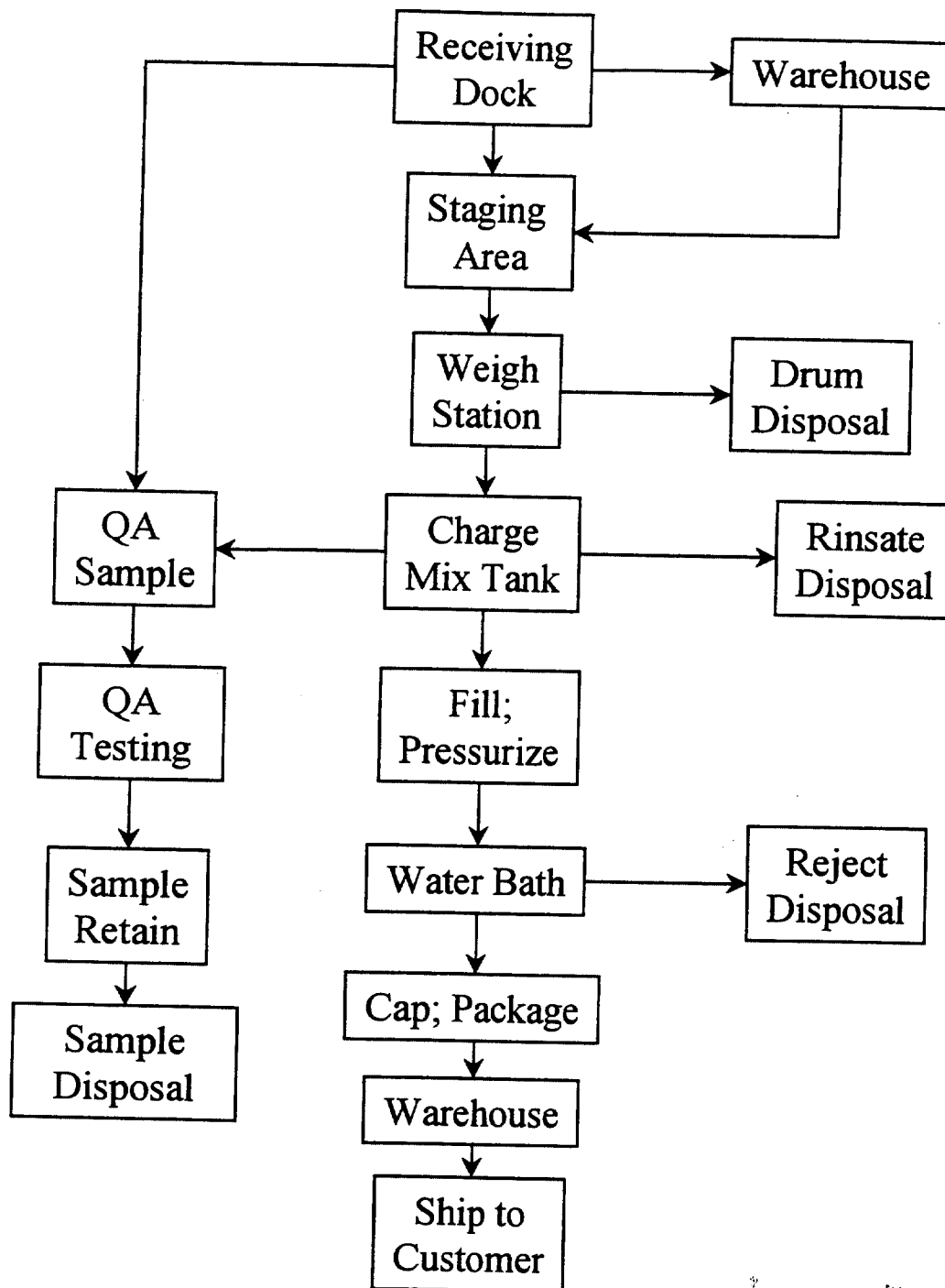
The following information describes the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used.

The distribution chain for the Retail Markets Products is not complex. Product is shipped from the manufacturer to the retailer with the possibility of one or more warehousing steps in between. During distribution, the product is in sealed aerosol cans. No significant exposure to the 3M product is anticipated during distribution. No charts are provided for the distribution chain.

The following charts provide points of likely contact with the 3M fluorochemical and fluorochemical-containing product during manufacture and customer use.

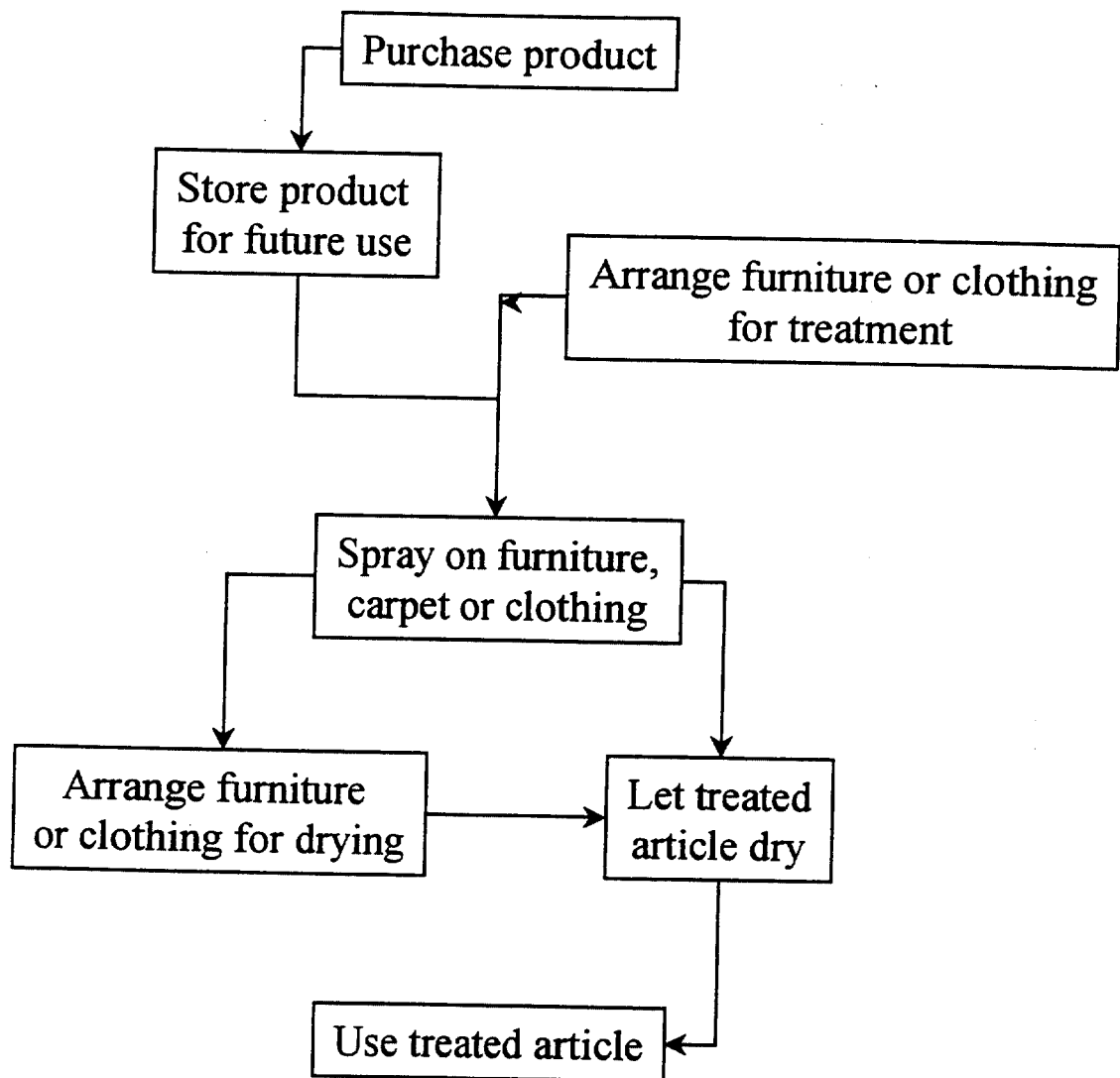
- This information was compiled from 3M internal knowledge of the manufacturing process and marketplace based on 3M technical service/sales visits and general information from customer interactions.

**RETAIL MARKETS PRODUCTS
AEROSOL MANUFACTURE
(HC-1,2,3,4,5; AA-1,2,3)**

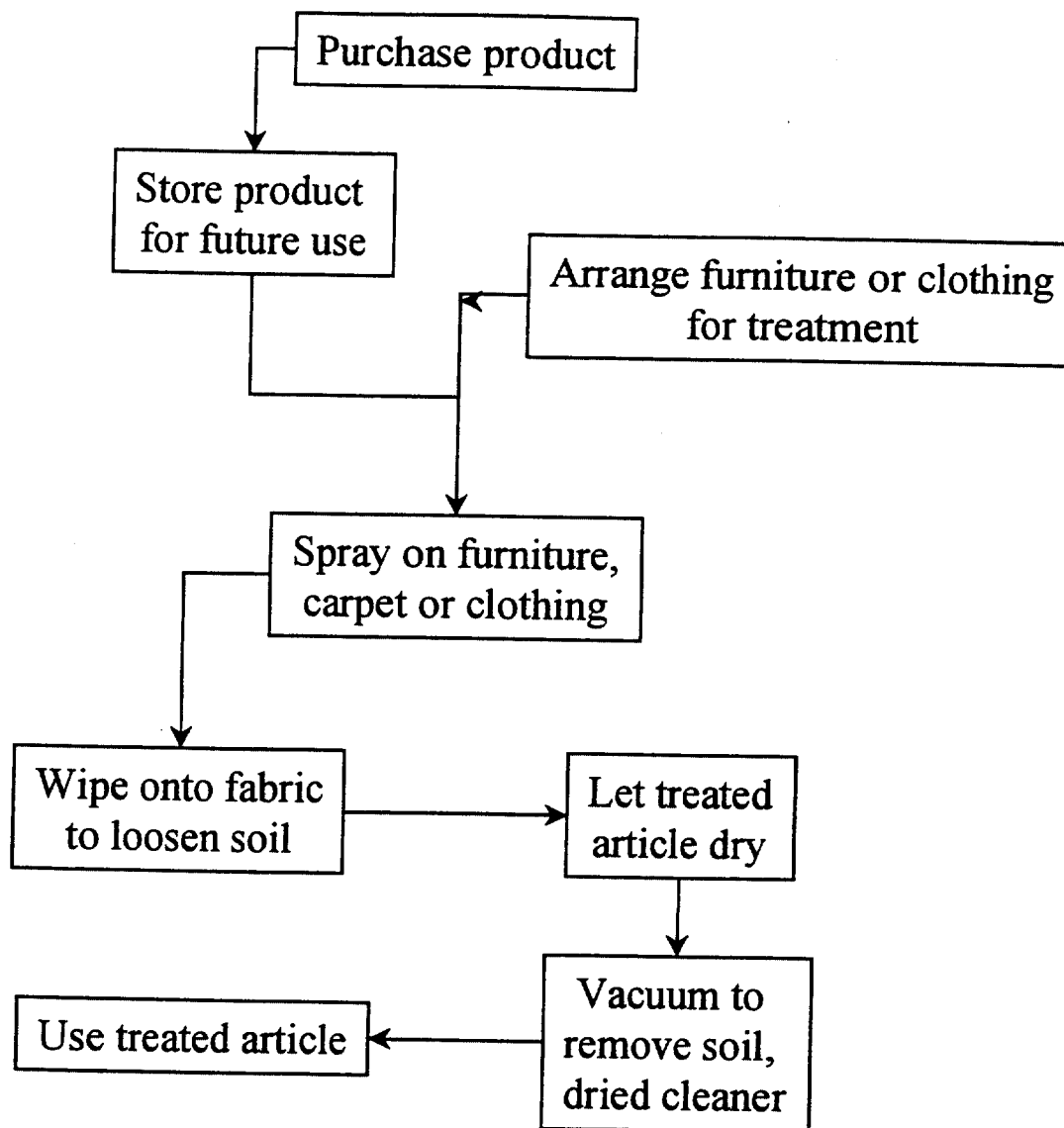


000161

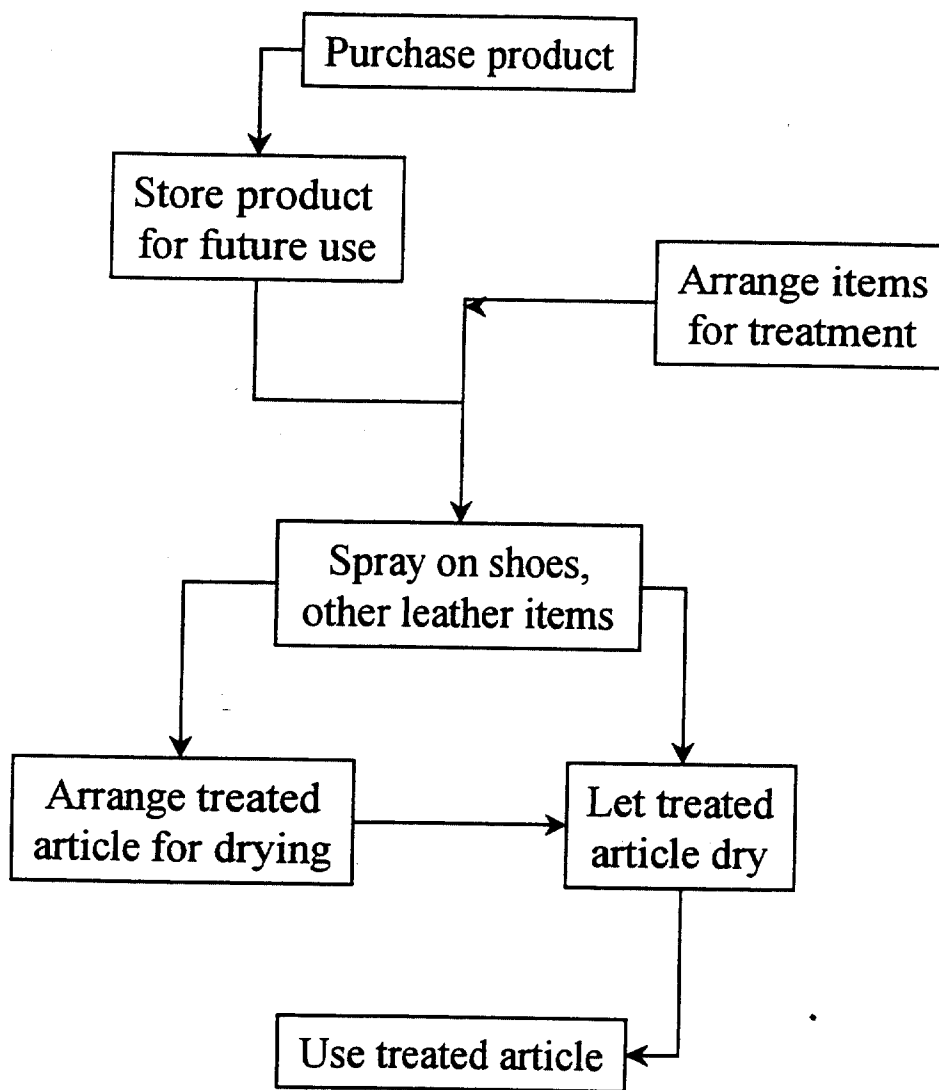
**RETAIL MARKETS PRODUCTS
HC-1, HC-4 APPLICATION**



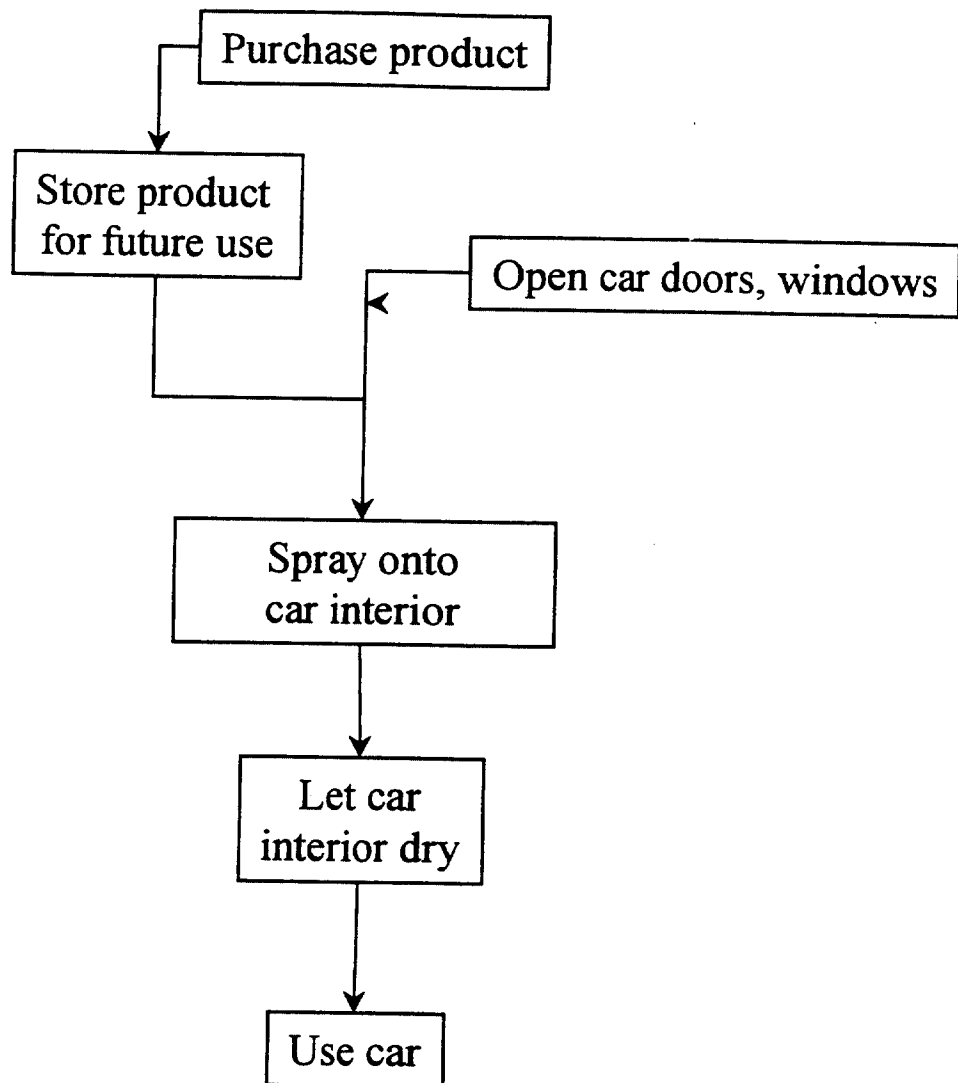
**RETAIL MARKETS PRODUCTS
HC-2, HC-3
APPLICATION**



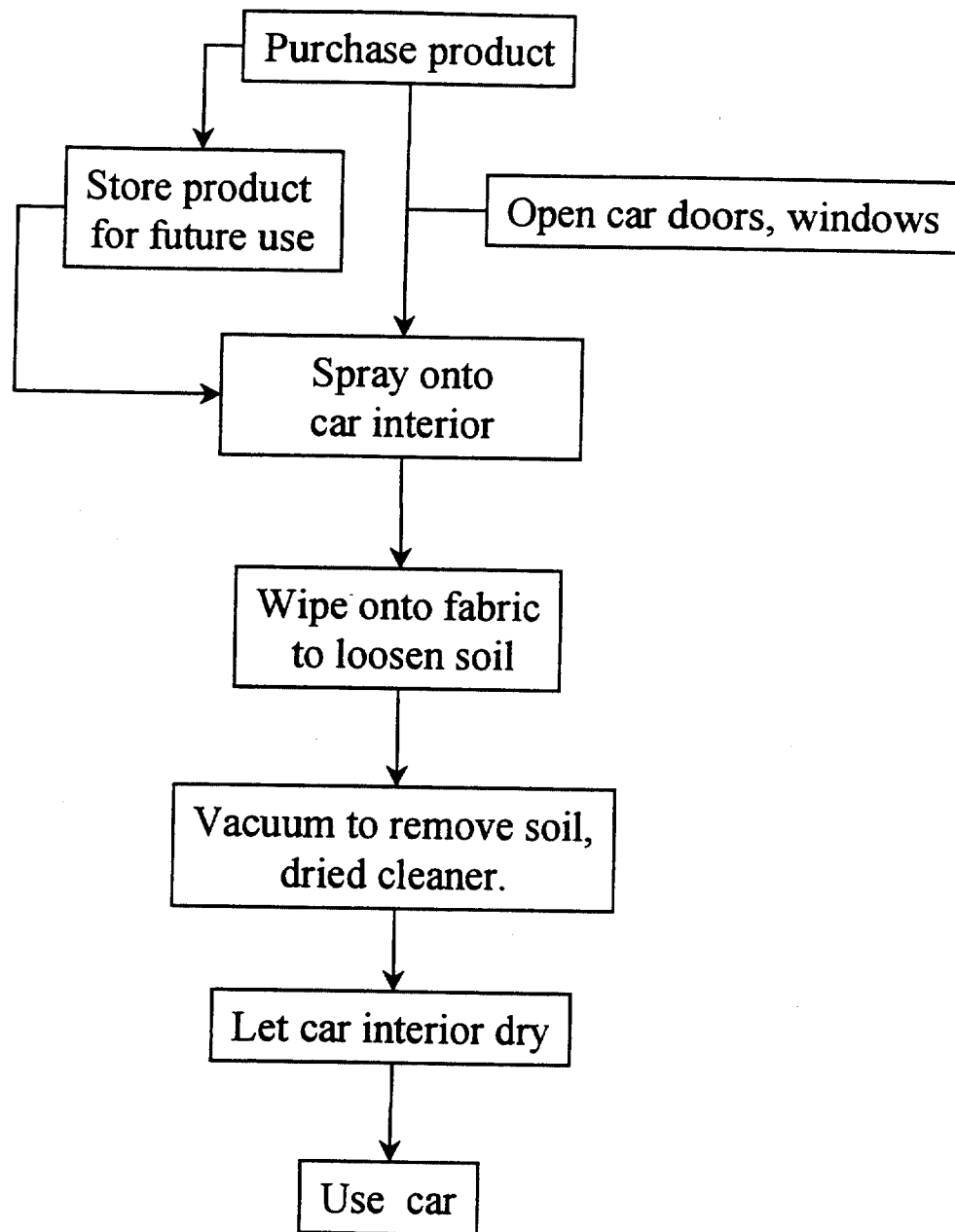
RETAIL MARKETS PRODUCTS HC-5 APPLICATION



**RETAIL MARKETS PRODUCTS
AA-1, AA-3 APPLICATION**



**RETAIL MARKETS PRODUCTS
AA-2 APPLICATION**



Retail Markets Products

3M Fluorochemical Exposure Information Summary

Based on the Distribution Chain/Points of Contact flow chart, each principal step in the manufacture and customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern. Use pattern includes steps in manufacture and end use application by the retail consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure at each point of contact -- ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during use. During end use application, "number of workers" represents number of occupants of residence present during and after product use.

Estimated Exposure Time: Indicates the amount of time that workers/end users potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System: Indicates open/closed status of product at time of handling as follows:
Open system is defined as one that allows workers to come in direct contact with 3M fluorochemical. Examples of open systems are mixing kettles, open drums and bottles.
Closed system is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical. Examples of closed systems are sealed drums and filled aerosol containers.

Comments: Provides additional descriptive information.

Disposal: Indicates most likely method of disposal of the end use product -- landfill, recycling or incineration. All end use products represented in these charts are packaged in aerosol cans. Disposal into the waterways or sewer system is not expected.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

**3M FLUORO-CHEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = HC-1

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	4	X					X	Closed containers. Spill response only.
STORAGE				6	<1	4	X					X	
STAGING				3	2	4	X					X	
WEIGH STATION		X		6	3	4	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	4	X		X		X		
FILLING				3	7	4	X				X		
PRESSURIZING				3	7	4	X					X	
BATH TEST				3	7	4	X					X	
CAPPING				3	7	4	X					X	
PACKAGING				6 - 20	7	4	X					X	Sealed aerosol cans. No exposure to contents.
WAREHOUSE				6	2	4	X					X	
SHIPPING				3	1	4	X					X	
DRUM DISPOSAL		X		3	<1		X				X		
QA DISPOSAL				3	<1		X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
— by user	X	X	X	1	0.02	2	X		X		X		
— by others in house	X	X		1.5	0	0	X		X				Assumes 2.5 per family
IMMEDIATELY AFTER APPLICATION													
— by user	X	X		1	?	2	X				X		Touching carpet
— by others in house	X	X		1.5	?	2	X				X		Touching carpet
AFTER DRYING				2.5	?	?		X					Physical contact; dust
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

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**3M FLUOROCEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = HC-2

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	1	X					X	Closed containers. Spill response only.
STORAGE				6	<1	1	X					X	
STAGING				3	2	1	X					X	
WEIGH STATION		X		6	3	1	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	1	X		X		X		
FILLING				3	7	1	X				X		
PRESSURIZING				3	7	1	X					X	
BATH TEST				3	7	1	X					X	
CAPPING				3	7	1	X					X	
PACKAGING				6 - 20	7	1	X					X	Sealed aerosol cans. No exposure to contents.
WAREHOUSE				6	2	1	X					X	
SHIPPING				3	1	1	X					X	
DRUM DISPOSAL		X		3	<1		X				X		
QA DISPOSAL				3	<1		X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
- by user	X	X	X	1	0.03	1	X		X		X		
- by others in house	X	X		1.5	0	0	X		X				Assumes 2.5 per family
IMMEDIATELY AFTER APPLICATION													
- by user	X	X		1	?	2	X				X		Touching wet carpet
- by others in house	X	X		1.5	?	2	X				X		Touching wet carpet
AFTER DRYING				2.5	?	?		X					Physical contact; dust
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

**3M FLUOROCEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = HC-3

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	1	X					X	Closed containers. Spill response only.
STORAGE				6	<1	1	X					X	
STAGING				3	2	1	X					X	
WEIGH STATION		X		6	3	1	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	1	X		X		X		
FILLING				3	7	1	X				X		
PRESSURIZING				3	7	1	X					X	
BATH TEST				3	7	1	X					X	
CAPPING				3	7	1	X					X	
PACKAGING				6 - 20	7	1	X					X	Sealed aerosol cans. No exposure to contents.
WAREHOUSE				6	2	1	X					X	
SHIPPING				3	1	1	X					X	
DRUM DISPOSAL		X		3	<1		X				X		
QA DISPOSAL				3	<1		X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
– by user	X	X	X	1	0.03	1	X		X		X		
– by others in house	X	X		1.5	0	0	X		X				Assumes 2.5 per family
IMMEDIATELY AFTER APPLICATION													
– by user	X	X		1	?	2	X				X		Moving wet furniture?
– by others in house	X	X		1.5	?	2	X				X		
AFTER DRYING				2.5	?	?		X					Physical contact; dust
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

**3M FLUORO-CHEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = HC-4

PRODUCT = HC-4														
Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers	Estimate Exposure Time		Physical Form				Open or Closed System		Comments	
	Ingestion	Dermal	Inhalation	(per day)	Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed		
MANUFACTURE														
REC'G DOCK				9	<1	24	X					X	Closed containers. Spill response only.	
STORAGE				6	<1	24	X					X		
STAGING				3	2	24	X					X		
WEIGH STATION		X		6	3	24	X				X		Same set of people for these four jobs	
CHARGING		X				24	X			X				
MIXING		X				24	X			X				
QA SAMPLING		X				24	X			X				
QA TESTING		X		3	7	24	X		X		X			
FILLING				3	7	24	X		X		X			
PRESSURIZING				3	7	24	X					X		
BATH TEST				3	7	24	X					X	Occasional leaker	
CAPPING				3	7	24	X					X		
PACKAGING				6 - 20	7	24	X					X	Sealed aerosol cans. No exposure to contents.	
WAREHOUSE				6	2	24	X					X		
SHIPPING				3	1	24	X					X		
DRUM DISPOSAL		X		3	<1	?	X				X			
QA DISPOSAL				3	<1	?	X		X		X			
CONSUMER APPLICATION:														
DURING APPLICATION														
- by user	X	X	X	1	0.07	2	X		X		X			
- by others in house	X	X		1.5	0	0	X		X				Assumes 2.5 per family	
IMMEDIATELY AFTER APPLICATION														
- by user	X	X		1	4	2	X				X		Moving wet furniture?	
- by others in house	X	X		1.5	4	2	X				X			
AFTER DRYING	X	X		2.5	12	365		X					Physical contact; dust	
DISPOSAL														
LANDFILL					?	?	X		X			X		
RECYCLING					?	?			X		X			
INCINERATION					?	?				X	X			

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**3M FLUOROCHEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = HC-6

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	4	X					X	Closed containers. Spill response only.
STORAGE				6	<1	4	X					X	
STAGING				3	2	4	X					X	
WEIGH STATION		X		6	3	4	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	4	X		X		X		
FILLING				3	7	4	X				X		
PRESSURIZING				3	7	4	X					X	
BATH TEST				3	7	4	X					X	
CAPPING				3	7	4	X					X	
PACKAGING				6 - 20	7	4	X					X	Sealed aerosol cans. No exposure to contents.
WAREHOUSE				6	2	4	X					X	
SHIPPING				3	1	4	X					X	
DRUM DISPOSAL		X		3	<1		X				X		
QA DISPOSAL				3	<1		X				X		
CONSUMER APPLICATION:													
DURING APPLICATION													
-- by user	X	X	X	1	0.02	1	X		X		X		
-- by others in house	X	X		1.5	0	0	X		X				Assumes 2.5 per family
IMMEDIATELY AFTER APPLICATION													
-- by user	X	X		1	?	2	X				X		Touching wet surface?
-- by others in house	X	X		1.5	?	2	X				X		
AFTER DRYING				2.5	?	?		X					Physical contact
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

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**3M FLUORO-CHEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = AA-1

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
RECG DOCK				9	<1	4	X					X	Drums closed except for QA sampling
STORAGE				6	<1	4	X					X	
STAGING				3	2	4	X					X	
WEIGH STATION		X					X				X		Same set of people for these four jobs
CHARGING		X		6	3	4	X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	4	X				X		
FILLING		X		3	7	4	X				X		
PRESSURIZING				3	7	4	X					X	
BATH TEST				3	7	4	X					X	
CAPPING				3	7	4	X					X	Sealed aerosol cans. No exposure to contents.
PACKAGING				6 - 20	7	4	X					X	
WAREHOUSE				6	2	4	X					X	
SHIPPING				3	1	4	X					X	
DRUM DISPOSAL		X		3	<1	4	X				X		
QA DISPOSAL				3	<1	?	X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
- by user	X	X	X	1	0.02	2	X		X		X		
IMMEDIATELY AFTER APPLICATION													
- by user	X	X		1	?	2	X				X		Touching wet surface(?)
- by others	X	X		1	?	2	X				X		
AFTER DRYING				2.5	?	?		X					Contact with treated surface; assume 2.5 per family
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

**3M FLUOROCEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = AA-2

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	1	X					X	Drums closed except for QA sampling
STORAGE				6	<1	1	X					X	
STAGING				3	2	1	X					X	
WEIGH STATION		X		6	3	1	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		7	7	1	X		X		X		
FILLING		X		3	7	1	X				X		
PRESSURIZING				3	7	1	X					X	
BATH TEST				3	7	1	X					X	
CAPPING				3	7	1	X					X	
PACKAGING				6 - 20	7	1	X					X	Sealed aerosol cans. No exposure to contents.
WAREHOUSE				6	2	1	X					X	
SHIPPING				3	1	1	X					X	
DRUM DISPOSAL		X		3	<1	1	X				X		
QA DISPOSAL				3	<1	?	X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
-- by user	X	X	X	1	0.03	1			X		X		
IMMEDIATELY AFTER APPLICATION													
-- by user	X	X		1	?	2	X				X		Touching wet surface(?)
-- by others	X	X		1.5	?	2	X				X		
AFTER DRYING				2.5	?	?		X					Contact with treated surface; assume 2.5 per family
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

**3M FLUOROCHEMICAL EXPOSURE INFORMATION
RETAIL MARKETS PRODUCTS**

PRODUCT = AA-3

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				9	<1	1	X					X	Drums closed except for QA sampling
STORAGE				6	<1	1	X					X	
STAGING				3	2	1	X					X	
WEIGH STATION		X		6	3	1	X				X		Same set of people for these four jobs
CHARGING		X					X				X		
MIXING		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X		3	7	1	X		X		X		
FILLING		X		3	7	1	X					X	
PRESSURIZING				3	7	1	X					X	
BATH TEST				3	7	1	X					X	Sealed aerosol cans. No exposure to contents.
CAPPING				6 - 20	7	1	X					X	
PACKAGING				6	2	1	X					X	
WAREHOUSE SHIPPING				3	1	1	X					X	
DRUM DISPOSAL		X		3	<1	1	X				X		
QA DISPOSAL				3	<1	?	X		X		X		
CONSUMER APPLICATION:													
DURING APPLICATION													
— by user	X	X	X	1	0.02	1	X		X		X		
IMMEDIATELY AFTER APPLICATION													
— by user	X	X		1	?	2	X				X		Touching wet surface(?)
— by others	X	X		1	?	2	X				X		
AFTER DRYING													
				2	?	?		X					Contact with treated surface; assume 2.5 per family
DISPOSAL													
LANDFILL							X		X			X	
RECYCLING									X		X		
INCINERATION										X	X		

Retail Markets Products

Product Volumes and Use Patterns Summary

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which information was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application. Generally the following definitions apply:

Process: use of fluorochemical-containing product in manufacture of another product; may include dilution prior to commercial distribution.

Application: use of fluorochemical-containing product to treat a substrate; may include product dilution by end user.

End Use: use of treated substrate .

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold per product in 1997 expressed in thousands (000). FC solids less than 1000 lb are indicated by approximate pounds displayed inside parentheses (--).

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration present in product during process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns

Retail Markets Products

Generic Code	Application, Process or End Use	Volume FC Solids Soid	FC Chemistry	Amount FC Present	Residuals In product	Use Pattern				Most Likely Route(s) of Exposure			Environmental Fate				Comments
		1997 (000 lb)		(wt% of pdt)	(wt% of pdt)												
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
Manufacture	Process						X			X			X		X		Treated materials and spent containers typically end up in landfill. Small percent
HC-1	App								X	X	X	X	X				
	End								X				X				
HC-2	App								X	X	X	X	X				
	End								X				X				
HC-3	App								X	X	X	X	X				
	End								X				X				
HC-4	App								X	X	X	X	X				
	End								X				X				
HC-5	App								X				X				
	End								X	X	X	X	X				
AA-1	App								X	X	X	X	X				
	End								X				X				
AA-2	App								X	X	X	X	X				
	End								X				X				
AA-3	App								X	X	X	X	X				
	End								X				X				

**End of
Retail Markets Products
Section**

Commercial Markets Products

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Product Volumes &
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Product Volumes &
Use Patterns Chart

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**FLUOROCHEMICAL IDENTITIES CHART
COMMERCIAL MARKETS PRODUCTS**

GENERIC CODE	CAS NUMBER	CAS NAME	FC CHEMISTRY NAME
CC-1, CC-2			
HC-6			
PC-1, PC-2			

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COMMERCIAL MARKETS PRODUCTS

Situation Analysis

BUSINESS DEFINITION

Commercial Markets Products have two distinct product categories:

- A) Cleaning and protection of commercial building and residential upholstery and carpet with 3M products by professional applicators. Cleaning and maintenance of floors, walls and other hard surfaces in commercial buildings by professional staff such as in-house custodians and independent contract cleaners.
- B) Treatment of consumer and professional film negatives by commercial photo processing facilities.

KEY PRODUCTS

A) 3M protectors and cleaner/protectors for commercial building and residential carpets and upholstery manufactured as liquids intended for spray application. (Hard surface cleaning products are not considered in the following sections because use of fluorochemicals in the formulations is at a very low level -- perhaps 0.1% of the formulation or less -- and because similar products and use patterns are considered in other market sections of this 3M assessment report.)

B) Liquid photocurable coating for film negatives. Cured, durable coating provides scratch and solvent protection for photographic film negatives.

KEY MARKETS

- A) Janitorial supply, professional supply houses
- B) Commercial film processing facilities

KEY CUSTOMERS

- A) Furniture retailers, building maintenance personnel, professional residential carpet cleaning services
- B) Individual retail consumers (photo negatives) and commercial/professional photographers.

INTENDED USE

- A) Treatment of carpet and upholstery for ultimate use in commercial buildings and residences
- B) Machine applied and cured (closed system) in a very thin coating on film negatives at commercial film processing facilities.

EXPECTED USE PATTERN

- A) Liquid water-based products applied using low pressure or paint-type spray apparatus. Articles are treated at the customer residence, in commercial buildings, or in the furniture retailers establishment.
- B) Film protector is applied by commercial applicators only. Cured, dry, treated film is handled by commercial and retail consumers.

Commercial Markets Products

Distribution Chain and Points of Contact

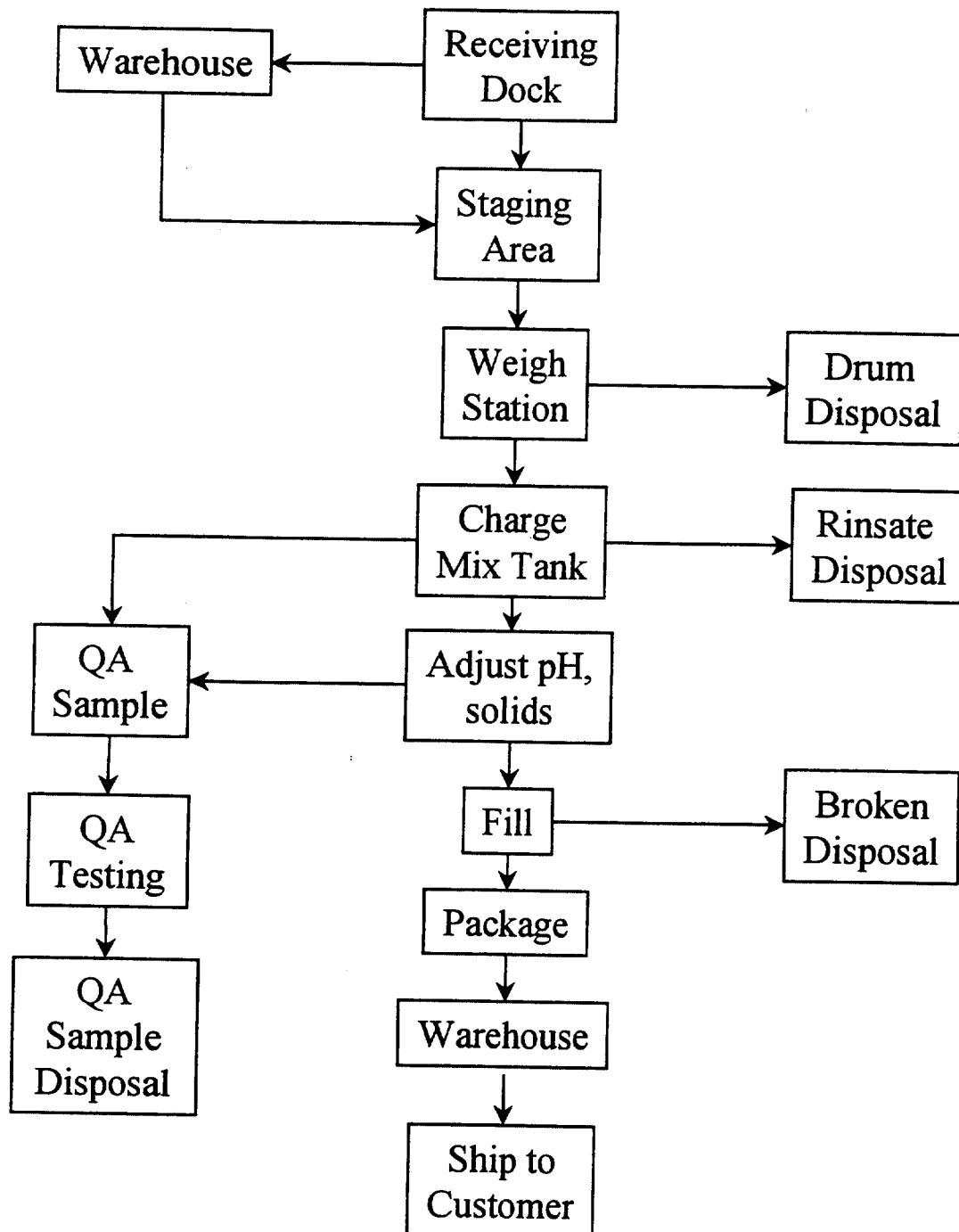
The following information describes the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used.

The distribution chain for the Commercial Markets Products is not complex. In general, product is shipped from the manufacturer to the distributor who sells to the end user. One or more warehousing steps may be involved. During distribution, the product is in sealed containers. In two instances, 3M product is reformulated to end use formulation or let down from concentrate to end use concentration in the distribution process. No charts are provided for the distribution chain. Reformulation and let down are considered in the points of contact charts.

The following charts provide points of likely contact with the 3M fluorochemical and fluorochemical-containing product during manufacture and customer use.

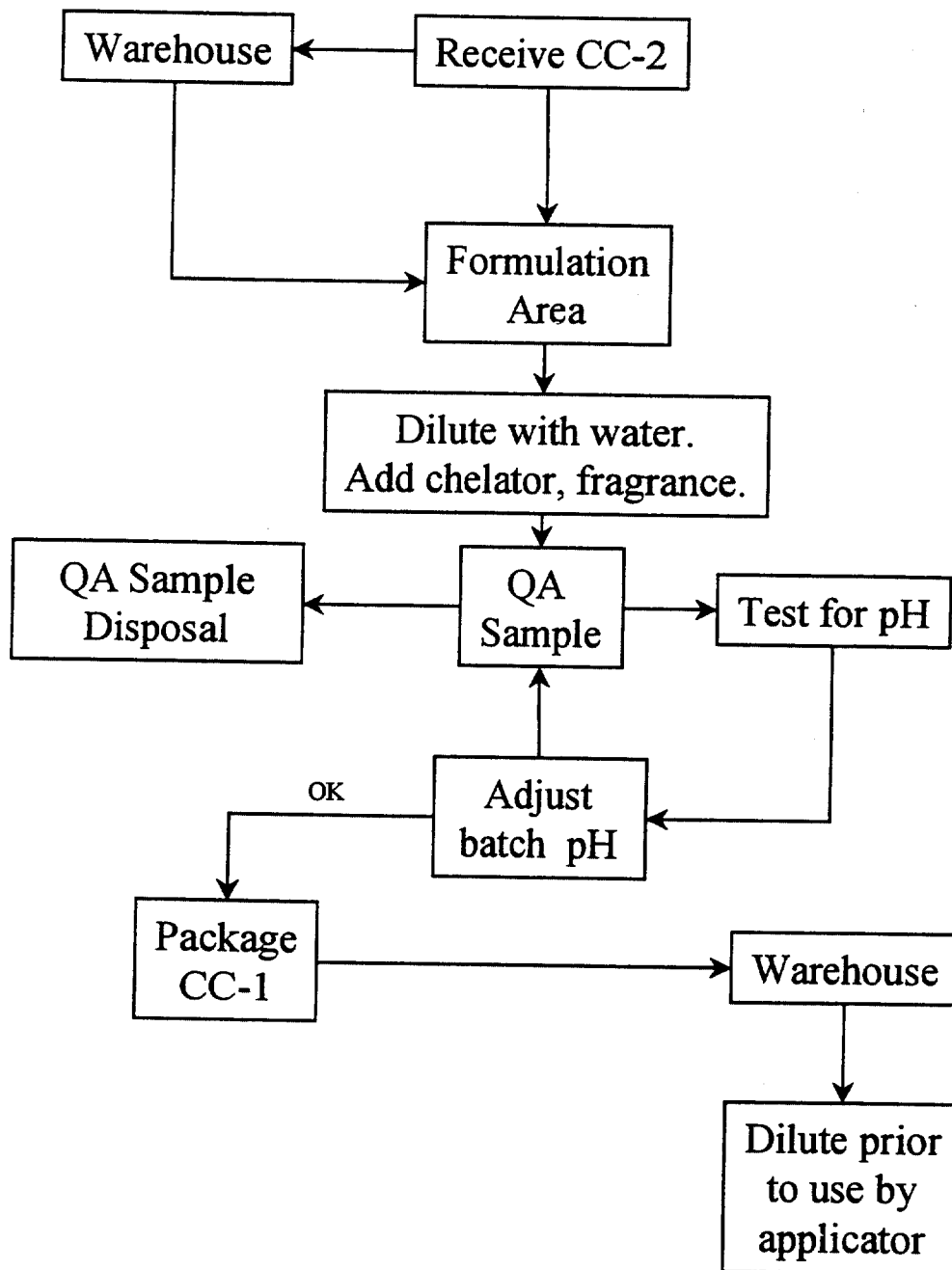
This information was compiled from 3M internal knowledge of the manufacturing process and marketplace based on 3M technical service/sales visits and general information from customer interactions.

**COMMERCIAL MARKETS PRODUCTS
CC-1, CC-2, HC-6 MANUFACTURE**

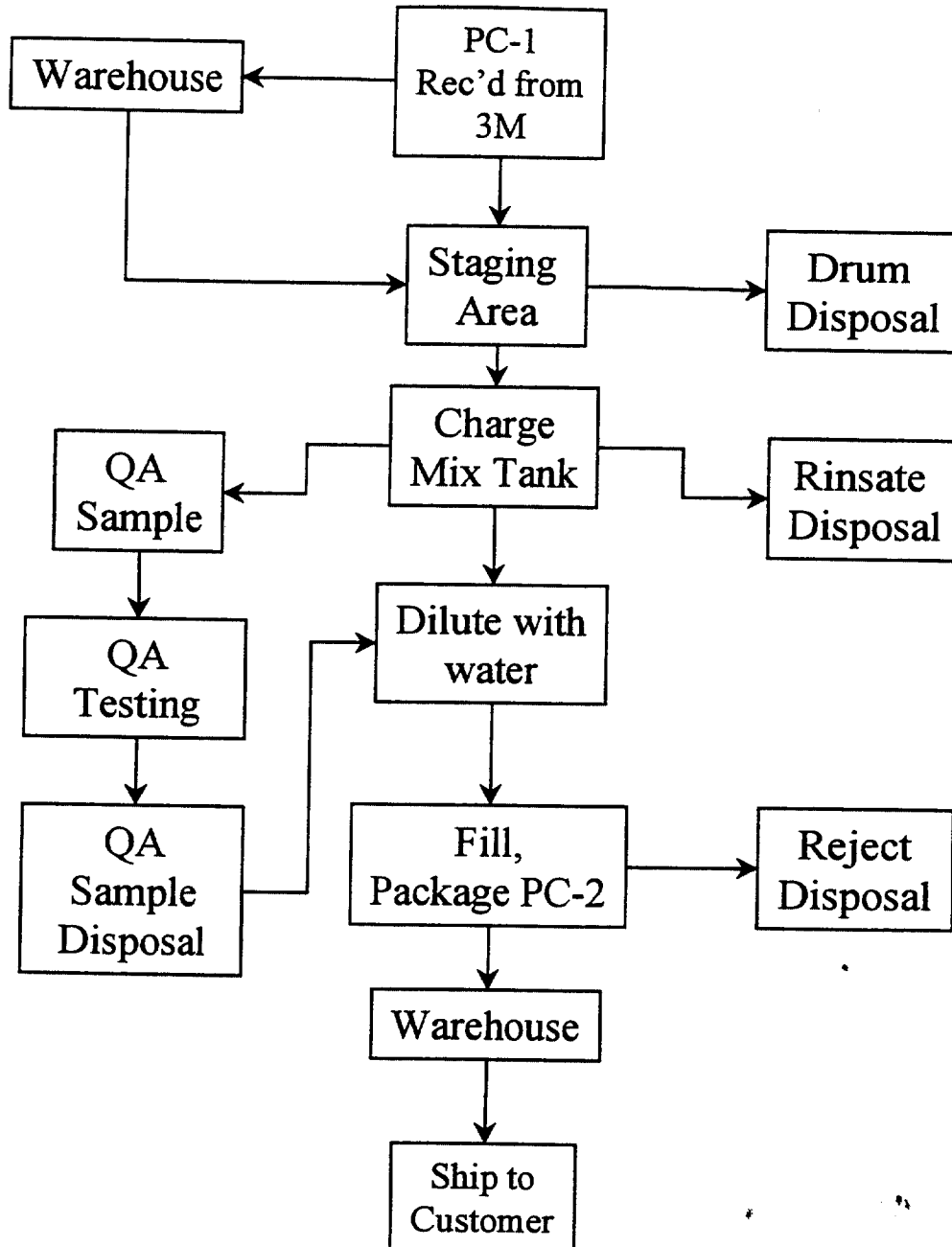


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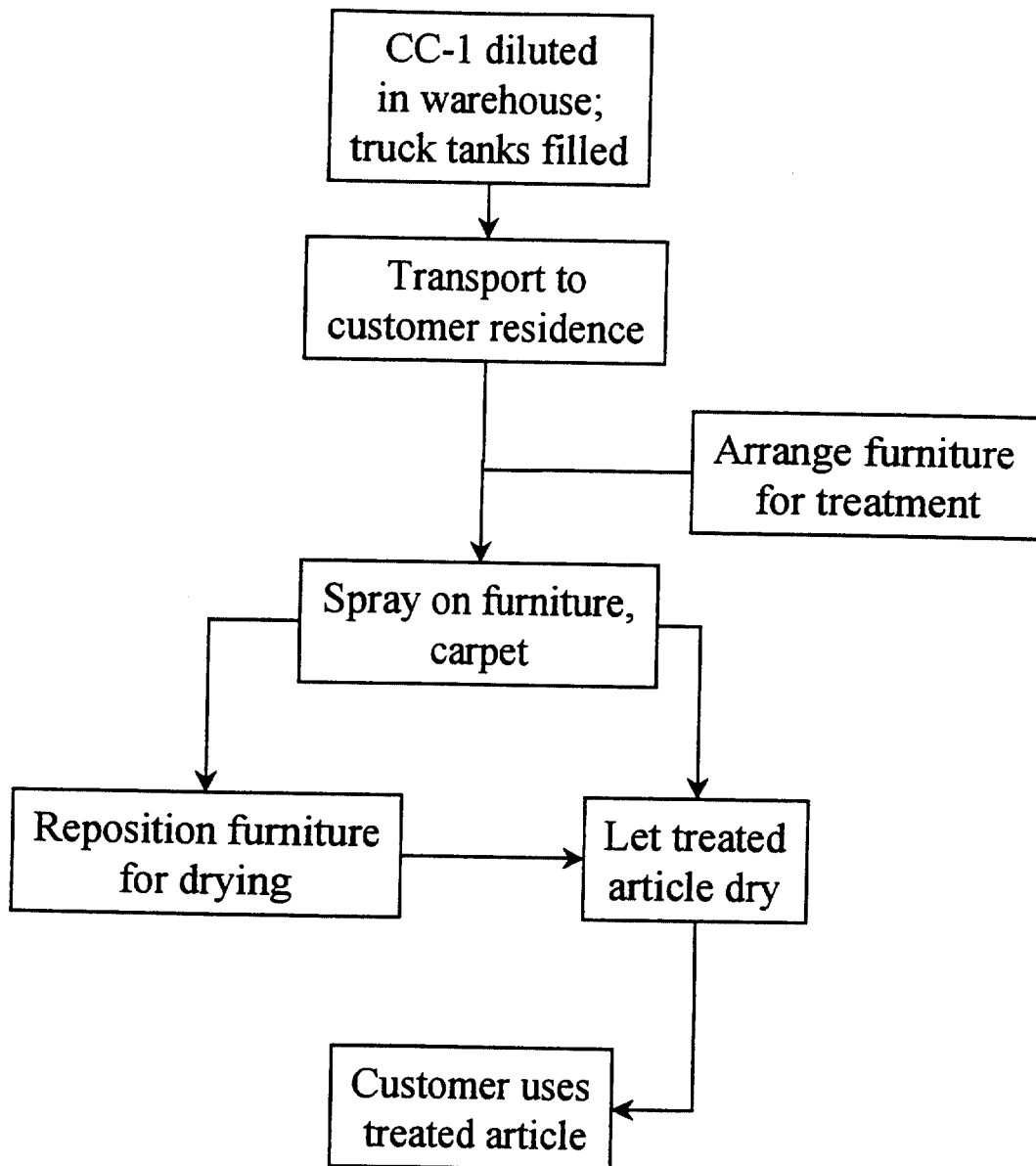
**COMMERCIAL MARKETS PRODUCTS
CC-1 MANUFACTURE
(Via Formulator)**



COMMERCIAL MARKETS PRODUCTS
PC-2 Manufacture
(Via Formulator)

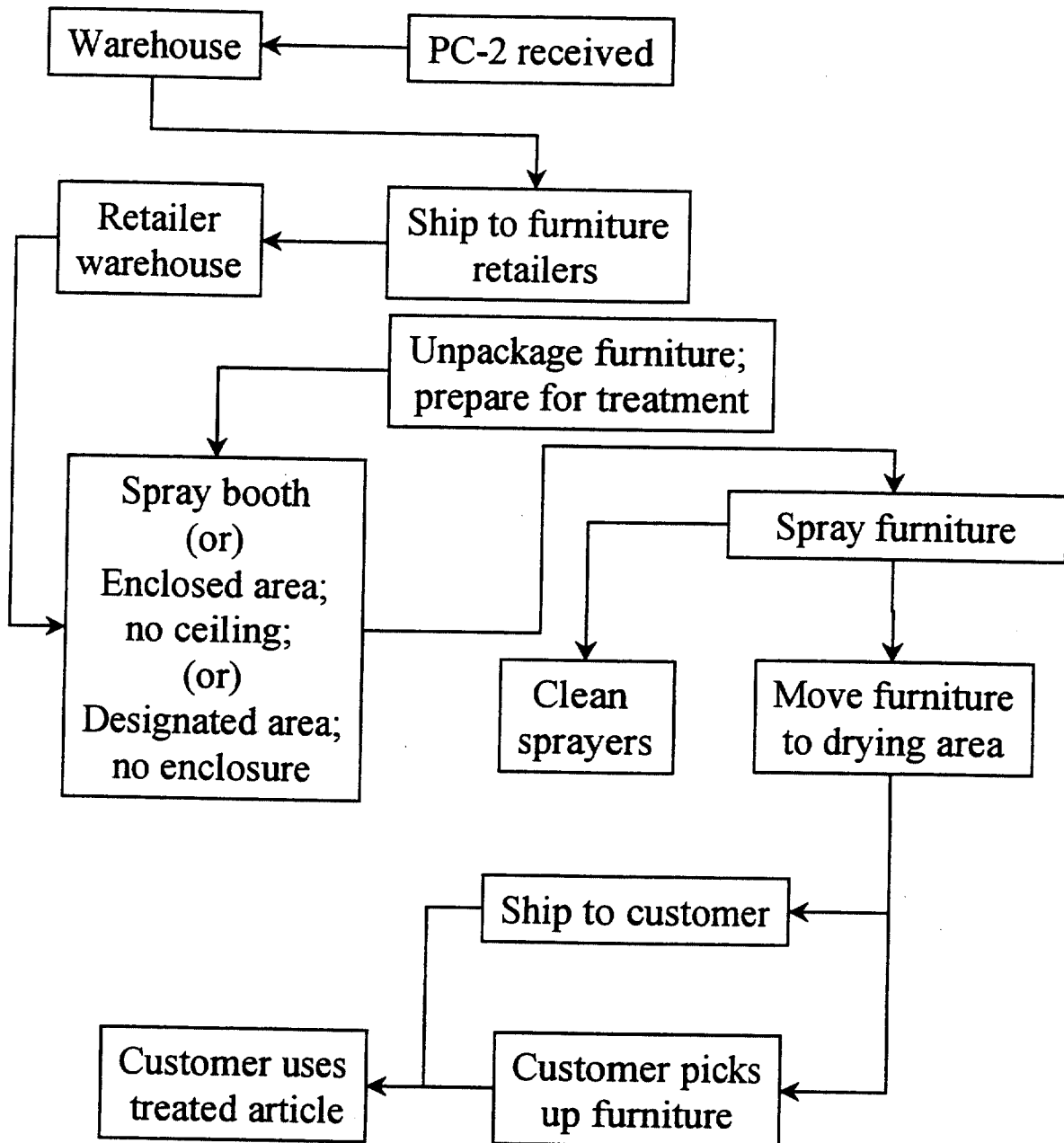


COMMERCIAL MARKETS PRODUCTS CC-1 APPLICATION



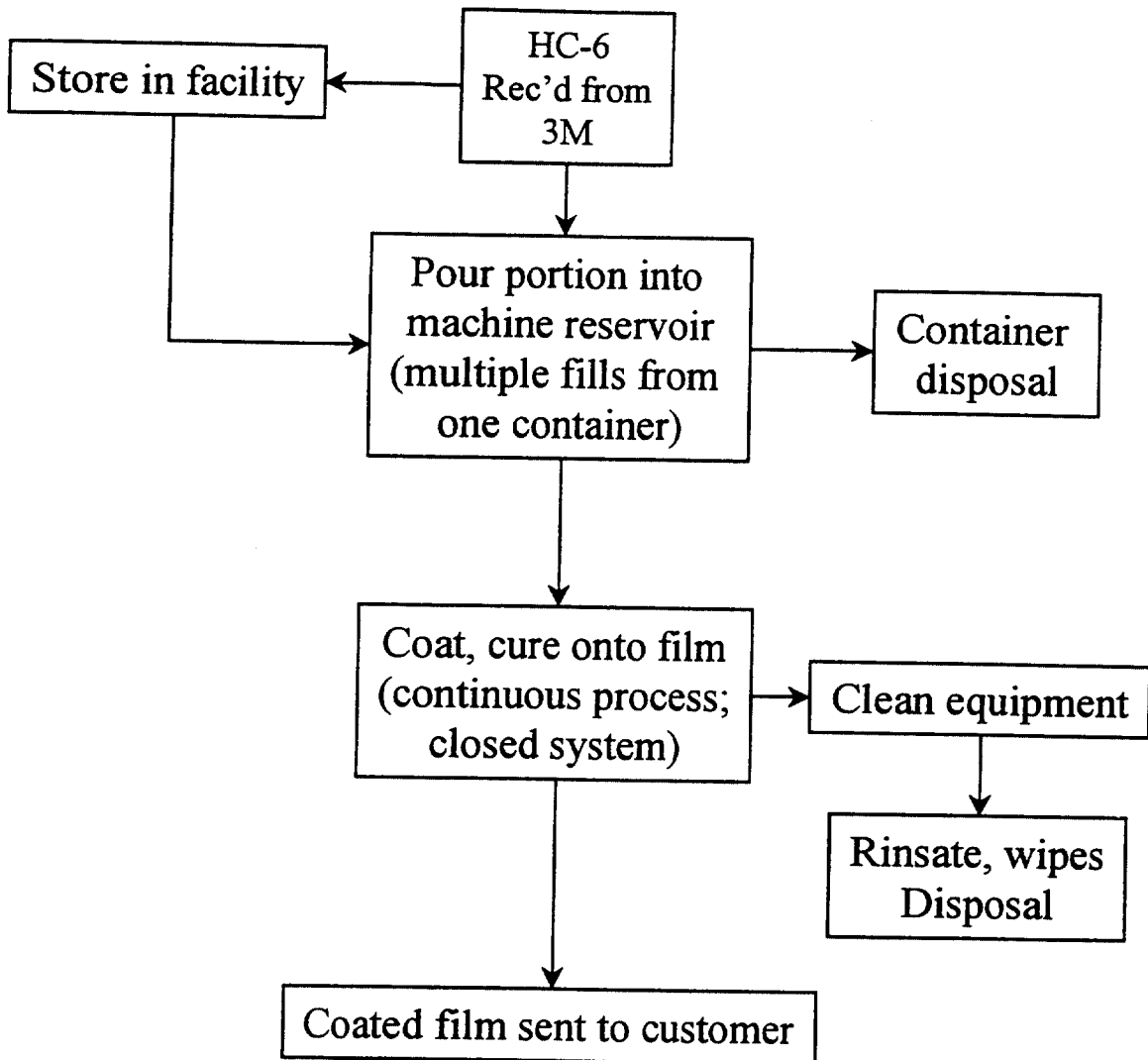
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COMMERCIAL MARKETS PRODUCTS PC-2 APPLICATION



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COMMERCIAL MARKETS PRODUCTS HC-6 APPLICATION



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Commercial Markets Products

3M Fluorochemical Exposure Information Summary

Based on the Distribution Chain/Points of Contact information, each principal step in the manufacture and customer use processes are isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern. Use pattern includes steps in product manufacture and end use application by the professional applicator.

Most Likely Route of Exposure: Identifies three potential routes of exposure at each point of contact -- ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during use. During end use application, "number of workers" represents number of occupants of residence present during and after product use as well as the professional applicator.

Estimated Exposure Time: Indicates the amount of time that manufacture workers/end users potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System: Indicates open/closed status of product at time of handling as follows: Open system is defined as one that allows workers to come in direct contact with 3M fluorochemical. Examples of open systems are mixing kettles, open drums and bottles. Closed system is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical. Examples of closed systems are sealed drums and filled sealed containers.

Comments: Provides additional descriptive information.

Disposal: Indicates most likely method of disposal of the end use product -- sewer, landfill, recycling or incineration.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

**3M FLUOROCEMICAL EXPOSURE INFORMATION
COMMERCIAL MARKETS PRODUCTS**

PRODUCT = CC-1, CC-2

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE (CC-1, CC-2)													
REC'G DOCK				2	<1	45	X					X	Closed containers. Spill response only.
STORAGE				2	<1	45	X					X	
STAGING					1	45	X					X	
WEIGH STATION		X			1	45	X				X		
CHARGING		X		2	2	45	X				X		
MIXING		X			<1	45	X				X		
QA SAMPLING		X			<1	45	X				X		
QA TESTING		X		1	1	45	X				X		
FILLING		X		2	7	45	X				X		
PACKAGING				3	7	45	X					X	Auto filler
WAREHOUSE				1	1	45	X					X	Sealed container
SHIPPING				1	1	45	X					X	
DRUM DISPOSAL		X		1	<1		X				X		Recycling?
QA DISPOSAL				1	<1		X				X		Retain; dispose
FORMULATOR													
Receive CC-2					<1	6	X					X	
Transfer to kettle; dilute; add charges	X	X	X		2	6	X				X		
QA sample; test for pH	X	X		1	1	6	X				X		
Adjust batch pH	X	X			1	6	X				X		
Package CC-1	X	X			2	6	X				X		
QA sample disposal					<1	6	X				X		
Warehouse					<1	6	X					X	
APPLICATOR													
RECEIVE CC-1													
DILUTE PRIOR TO USE		X		1	1	250	X				X		Prior to transport to customer site
DURING APPLICATION													
- by applicator		X	X	1	0.10	250	X				X		Applicator
- by others in house				2	<1	<1	X						Residents
IMMEDIATELY AFTER APPLICATION													
- by applicator		X		1	<1		X				X		Moving wet furniture?
- by others in house		X		2	<1		X				X		Walking/touching wet surface?
AFTER DRYING													
				2,5	12	250		X					Physical contact; dust by residents of home
DISPOSAL													
SEWER		X		1			X				X		Spent liquid
LANDFILL							X				X		Empty containers
RECYCLING							X				X		Empty containers
INCINERATION							X				X		Empty containers

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**3M FLUOROCEMICAL EXPOSURE INFORMATION
COMMERCIAL MARKETS PRODUCTS**

PRODUCT = PC-2

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				1	1	90	X					X	Pdt in sealed containers
WAREHOUSE							X					X	
STAGING							X					X	
CHARGING		X		3	3	90	X				X		
MIX WITH WATER		X					X				X		
QA SAMPLING		X					X				X		
QA TESTING		X					X				X		
FILLING		X		6	4	90	X				X		
PACKAGING							X					X	
WAREHOUSE				1	1	50	X					X	Pdt in sealed containers.
SHIP TO													
APPLICATOR							X					X	Output is 5 gal and 30 gal containers
DRUM DISPOSAL		X		1	1	90	X				X		
QA DISPOSAL				1	<1	4	X				X		Put back into mix
TANK RINSE		X		1	2	2	X				X		Pressure wash rinsates sent to 3M for disposal
APPLICATOR													
RECEIVE PRODUCT				1	1	12	X					X	Sealed containers
WAREHOUSE				1	1	12						X	
SHIP TO FURNITURE				2-3	7	250	X					X	
RETAIL				1	1	12	X					X	
WAREHOUSE				1	1	12	X					X	Containers remain in area for further use
MOVE TO SPRAY BOOTH		X		1	1	12	X				X	X	
SPRAY FURNITURE	X	X	X	2	3	350	X				X		
MOVE TO DRYING AREA	X	X					X				X		
DELIVER TO CUSTOMER		X		2	4	250	X				X		Depending on drying conditions, time of drying and amount of pdt applied, furniture may be damp when delivered
CUSTOMER													
PICK UP FURNITURE	X	X		2	1	350		X			X		Depending on drying conditions, time of drying and amount of pdt applied, furniture may be damp when picked up
USE FURNITURE				2.5	12	350	X	X			X		
DISPOSAL													
SEWER		X		1	<1	250	X				X		Spent liquid
LANDFILL							X	X				X	Rags, wipes, floor sweepings, furniture wrapping and furniture discarded by consumer
RECYCLING							X				X		Empty containers (?)
INCINERATION (?)							X				X		

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**3M FLUOROCHEMICAL EXPOSURE INFORMATION
COMMERCIAL MARKETS PRODUCTS**

PRODUCT = HC-6

Point of Contact	Most Likely Exposure Route(s)			Estimated Number of Workers (per day)	Estimate Exposure Time		Physical Form				Open or Closed System		Comments
	Ingestion	Dermal	Inhalation		Hr/day	Days/Yr	Liquid	Solid	Aerosol	Vapor	Open	Closed	
MANUFACTURE													
REC'G DOCK				1	1	50	X					X	Pdt in sealed containers
WAREHOUSE							X					X	
STAGING							X					X	
CHARGING		X		1	1	50	X				X		
QA SAMPLING		X					X				X		
QA TESTING		X					X				X		
FILLING		X		1	1	50	X				X		
PACKAGING							X					X	
WAREHOUSE							X					X	Pdt in sealed containers.
SHIP TO CUSTOMER				?	?	?	X					X	
DRUM DISPOSAL		X		1	1	50	X				X		
QA DISPOSAL		X		1	<1	?	X				X		
TANK RINSE		X		1	1	50	X				X		
APPLICATOR													
RECEIVE PRODUCT				1	1	?	X					X	Sealed containers
STORE IN FACILITY				1	1	?						X	
POUR INTO COATER		X		1	0.5	250	X				X		
COAT, CURE FILM				1	8	250	X					X	Closed system
CLEAN COATER		X		1	0.5	250	X				X		
RINSE, WIPE DISPOSAL		X		1	0.1	?	X				X		
SEND FILM TO CUSTOMER													
CUSTOMER													
USE FILM		X		?	?	?		X			X		Cured treated film only. Customer not exposed to end use product.
DISPOSAL													
SEWER													
LANDFILL RECYCLING								X			X		Rags, wipes discarded by applicator; treated film discarded by consumer
INCINERATION							X				X		Mfg waste possibly sent to industrial incinerator

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Commercial Markets Products

Product Volumes and Use Patterns Summary

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which information was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application. Generally the following definitions apply:

Process: use of fluorochemical-containing product in manufacture of another product; may include dilution prior to commercial distribution.

Application: use of fluorochemical-containing product to treat a substrate; may include product dilution by end user.

End Use: use of treated substrate .

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997 expressed in thousands (000); FC solids less than 1000 lb are indicated by approximate pounds displayed inside parentheses (--).

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration present in product during process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates. "ND" indicates residual level not determined.

Use Pattern: Indicates the major sector where product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns

Commercial Markets Products

Generic Code	Application, Process or End Use	Volume FC Solids Sold	FC Chemistry	Amount FC Present	Residuals in product	Use Pattern				Most Likely Route(s) of Exposure			Environmental Fate				Comments
		1997 (000 lb)		(wt% of pdt)	(wt% of pdt)	Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
Manufacture	Process	=== See Below ===					X			X			X		X		
CC-1	End							X	X		X		X		X		Treated articles ultimately into landfill. Spent solutions sewered
CC-2	Process							X		X			X		X		
HC-6	App							X		X			X	X			100% solids, UV cured material. Closed system application and cure. Process waste expected to be minimal.
	End								X	X			X				Consumer exposure only to fully cured coating on film. Treated articles ultimately into landfill.
PC-1	Process						X			X					X		Treated articles ultimately into landfill. Spent solutions sewered
PC-2	End							X		X	X		X		X		

**End of
Commercial Markets Products
Section**

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**END OF FLUOROCHEMICAL USE,
DISTRIBUTION AND RELEASE
OVERVIEW**


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Performance Chemicals Fluorochemical Use, Distribution And Release Overview

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Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in Performance Chemicals business. It attempts to answer the following questions.

- What products are customers exposed to?
- Where does exposure happen?
- What type of exposure is it?

The 3M fluorochemical business is complex and global. Markets served are highly fragmented involving multiple 3M products that are applied to multiple substrates, sold into multiple market segments and used for multiple end products.

Sources

Information for this report was developed solely from internal 3M sources. These include:

- Knowledge of product handling and use practices from field sales and technical personnel
- Best estimates of end-use applications from known customer activities
- Internal sales reports
- Knowledge of worldwide activities (where applicable) by St. Paul based-personnel

How To Read This Report

Situation Analysis:

Provides background on business and products.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical throughout the distribution chain to final end user. Objective is to identify all points of contact with our chemicals – from arrival on customer's Loading dock through product usage and disposal.

Exposure Information Charts:

Attempts to quantify type and length of exposure and number of workers exposed to our Chemicals within the distribution chain.

Product Volumes and Use Patterns:

Combines 3M product detail with the exposure routes to provide a summary of total business exposure by product type.

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 - 1. Business Definition
 - 2. Products and Markets
 - 3. Customer Location
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 - C. Metal Plating and Electronic Etching Baths**
 - 1. Business Definition
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1. Business Definition
2. Products and Markets
3. Customer Location

H. Insecticides

1. Business Definition
2. Products and Markets

III. Exposure Assessment

A. Fire-fighting Foam

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Patterns

B. Mining and Oil

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Patterns

C. Metal Plating and Electronic Etching Baths

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Pattern

D. Household Additives

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Patterns

E. Intermediates

1. Distribution Chain
2. Points of Contact

3. Exposure Routes
4. Production Volumes and Use Patterns

F. Coatings and Coating Additives

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Patterns

G. Carpet Spot Cleaners

1. Distribution Chain
(Points of Contact, Exposure Routes done by Home and Commercial Care Products Division)
3. Production Volumes and Use Patterns

H. Insecticides

1. Distribution Chain
2. Points of Contact
3. Exposure Routes
4. Production Volumes and Use Patterns

Chemical Names

The following is a list of Chemical Abstract Services (CAS) names and numbers for individual products. The following information is presented:

Generic Code: Indicates an internal 3M designation of the product(s).

CAS Number: Indicates the Chemical Abstracts Services number(s) of fluorochemicals contained within each product.

Chemical Name (complete CAS name or IUPAC names if CAS name does not exist):
Indicates the Chemical Abstracts Services name(s) of fluorochemicals contained within each product.

Chemical Class: Indicates a shortened, generic chemical name.

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Household Additives			
HA-1, PE-2			
HA-2			
HA-3, MO-7			
HA-4, CA-1			
HA-5, CA-2, MO-5, MO-1			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
HA-6, PE-3			
Metal Plating/Electronic Etching			
PE-1			
PE-4			
Intermediates			
IM-1			
IM-2			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
IM-3			
IM-4			
IM-5			
Coatings, Coating Additives, and Inks			
CA-3			
CA-4, MO-3			
CA-5			
CA-6			

Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Insecticides			
IC-1			
IC-2			
Mining/Oil			
MO-2, MO-6			
MO-4			
Fire-fighting Foams			
FF-1 to FF-13			
Carpet Spot Cleaner			
CC-1			

IV. Situation Analysis

A. Fire Fighting Foams

1. Business Definition

Fire Protection Industry – Description: Light Water™ and ATC™ are trademarks for class B fire foam products manufactured by 3M that are aqueous film forming foams (AFFF) and alcohol resistant concentrate (AR-AFFF) used to suppress and/or extinguish flammable liquid fires and suppress flammable liquid and toxic chemical vapors. Branded foams are manufactured as well as commercial, competitively priced AFFF's and AR-AFFF's.

a) Fluorochemical Foam Surfactant Converter Segment

This segment is comprised of companies who purchase fluorochemical intermediates and convert them by means of a chemical reaction to organic fluorochemical surfactants for use in formulating flammable liquid fire fighting foam. Other than 3M, who convert their own intermediates to surfactants, most surfactant manufacturers in the United States either convert their own intermediates, or obtain their intermediates from companies other than 3M. 3M intermediates that end up in fire fighting foam are non-existent in the United States, but could end up in the United States from sources outside the United States where we do sell intermediates for this segment.

b) Foam Formulator Segment:

This segment is comprised of companies that formulate their own AFFF products from Fluorochemical surfactants, or mixtures of surfactants called superconcentrates or concentrated agents.

c) Fire Extinguisher Concentrate Segment:

This segment is comprised of companies who manufacture fire extinguishers, from one-gallon equivalent portable up to three hundred or more gallon fixed or wheel mounted ready to use fire fighting systems.

d) Foam Flammable Liquid Fire Fighting Segment:

This segment is comprised of all users of AFFF and AR-AFFF Foam. These are the end users, usually described as "fire fighters". A fire fighter uses the concentrate by

educting, or mixing it with water at the time of fighting a fire, either by mixing it with water as a pre-mix, or using fire fighting equipment that proportions the concentrate with water as it is used. Another form of fire fighting with foam is where a fixed system, containing the concentrate, is either manually or automatically activated causing the system to force the concentrate into a water stream where the "mixture" is forced through sprinkler heads or an automatic monitor directly to the fire. The "fire fighter" will also use foam from a fixed installation for application directly to a flammable liquid that is burning or is emitting flammable/toxic vapors.

2. Products and Markets:

Foam concentrate (identified in IV.a 3) use by the "fire fighter" either manually or automatically are used in the following market areas:

<u>Market Area</u>	<u>Description</u>
Oil & Chemical Industry	Chemical plants, petroleum refineries, terminal storage facilities, transportation (excluding marine)
Sprinkler Systems	Purchasers of foam concentrates for inclusion in end-user products (i.e., foam/water sprinklers, fire trucks)
Marine	Water transportation vessels
Fire Brigades	Local government fire protection services
Civil Aviation	Airports (Crash fire rescue)
Off-Shore	Total drilling platform protection systems
Military	Federal/national government armed forces
Hazardous Waste	Environmental Clean-up Companies

<u>Product Code</u>	3.	<u>Key Product Sales</u> <u>Lbs. PE-1 Solids Per Gallon</u>	<u>Gallons Sold</u>
FF-1			
FF-2			
FF-3			
FF-3A			
FF-3B			
FF-4			
FF-5			
FF-5A			
FF-5B			
FF-5C			
FF-5D			
FF-6			
FF-6A			
FF-7			
FF-8			

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II. Situation Analysis

B. Mining and Oil

Mining -- This segment includes copper and gold mines that process ore via solution mining. The mines use 3M surfactants to increase wetting of the sulfuric acid or cyanide that leaches the ore. This increases the amount of metal recovered from the ore. 3M surfactants are sold directly to the mines.

Oil - This segment includes oil well service formulators and oil companies that use 3M surfactants in a well stimulation formula that is injected into an oil well to enhance the recovery of oil and gas. 3M surfactants are sold direct, to formulators and through a distributor.

<u>Products</u>	<u>(000) Pounds</u>
MO-1	
MO-2	
MO-4	
MO-3	
MO-6	
MO-7	
MO-5	

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C. Metal Plating and Electronic Etching Baths

Metal Plating- This segment includes chrome and plastic preplate etchant platers who use 3M surfactants to suppress oxidizing acid mist in order to protect their operators health in compliance with NIOSH regulations. 3M surfactants are sold either as powders to formulators who manufacture solid pellets that are sold to the platers or as liquids that are sold directly to the platers

Electronic Etching- This segment includes the electronics manufacturers who add 3M surfactants to strong acids in order to etch precise patterns in a silicon wafer or a printed circuit board. 3M surfactants are either sold to formulators who purify and dilute the surfactants before selling them to the end user or sold directly to the wafer manufacturer

<u>Products</u>	<u>Pounds</u>
PE-4	
PE-1	
PE-3	

D. Household Additives

This segment includes chemical formulators who use 3M surfactants to improve the wetting of water-based products that are sold as cleaners, waxes, floor polishes, surface protective compounds, and photographic film. 3M surfactants are sold as liquids to the formulators who dilute them to about 20 parts per million in their product that is sold to the consumer or contract cleaner.

<u>Products</u>	<u>Pounds</u>
HA-1	
HA-2	
HA-6	

E. Intermediates

This segment includes chemical manufacturers who react 3M fluorochemical intermediates with monomers in order to create a fluorochemical polymer. The manufacturers handle 3M intermediates in a way similar to the way 3M processes 3M intermediates to make surfactants for 3M "Light Water" fire protection foam or fluorinated polymers with residues similar to "Scotchgard" carpet protector.

<u>Products</u>	<u>Pounds</u>
IM-1	
IM-2	
IM-3	
IM-4	

F. Coatings and Coating Additives

Coatings-This segment includes formulators who utilize 3M fluorochemical polymer coatings as received or in combination with other materials to impart soil or water repellency to a surface. Typical applications include application of such coating to household or commercial surfaces or electronic or electronic components.

<u>Products</u>	<u>Pounds</u>
CA-5	
CA-6	

Coating Additives-Some formulators of protective coatings utilize very low levels of 3M surfactants (fractions of a percent) to enhance wetting, flow, leveling, and performance and to permit reductions in the amount of hazardous solvents and other volatile organic compounds required in such systems.

<u>Products</u>	<u>Pounds</u>
CA-1	
CA-2	
CA-3	
CA-4	

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G. Carpet Spot Cleaners

This segment includes formulators of carpet spot cleaners who use 3M fluorochemicals to provide stain and soil resistance to carpet. The consumer sprays the product on carpet

Products

CS-1

Pounds

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H. Insecticides

This segment includes formulators of insect control bait stations who use 3M fluorochemicals as registered active ingredients. 3M fluorochemicals are blended with bait that is attractive to the insect and placed in bait stations for leaf cutter ants, pharoah ants and cockroaches.

<u>Products</u>
IC-2
IC-1

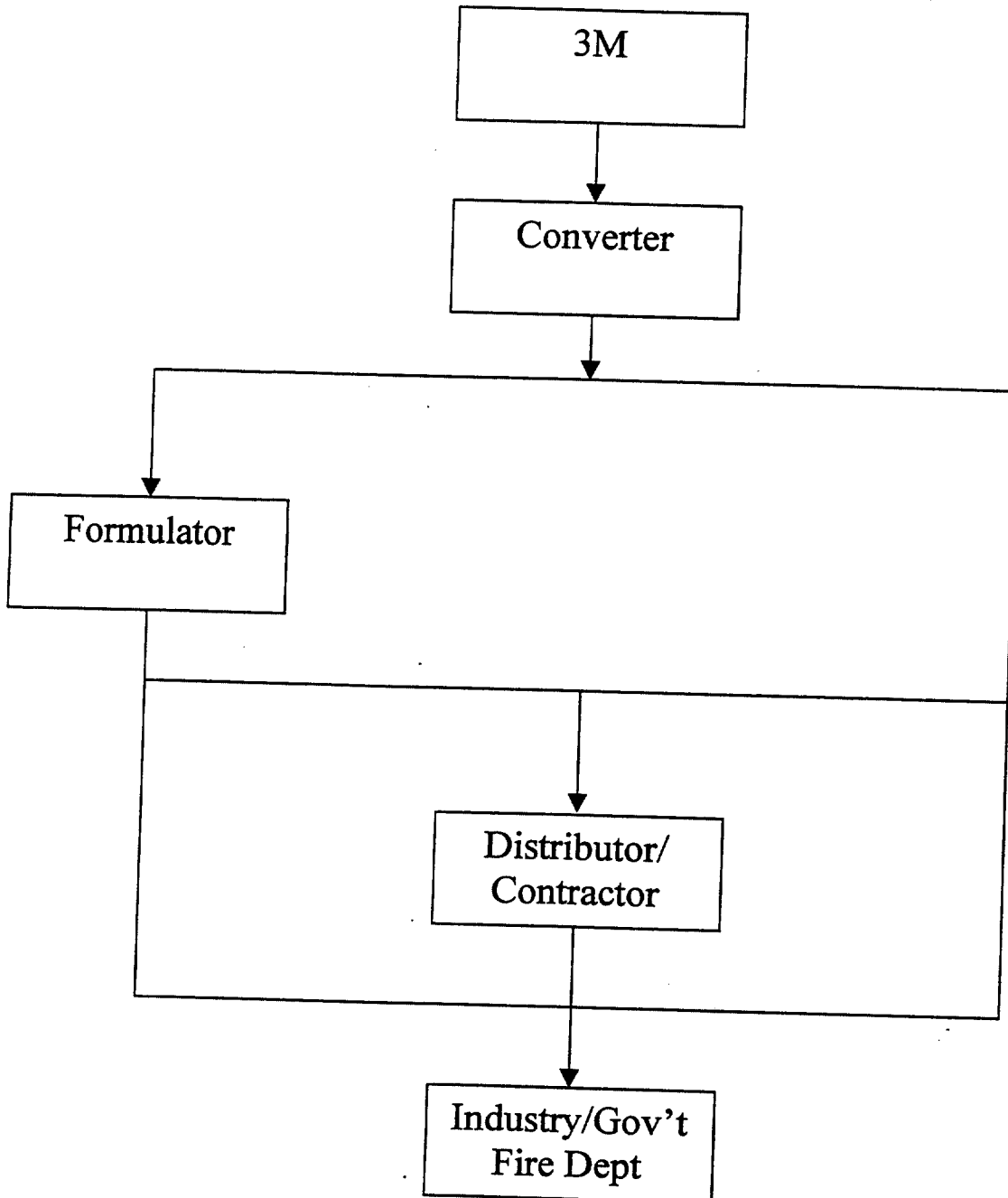
<u>Pounds</u>

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

AFFF Surfactant Converter Segment

Distribution Chain

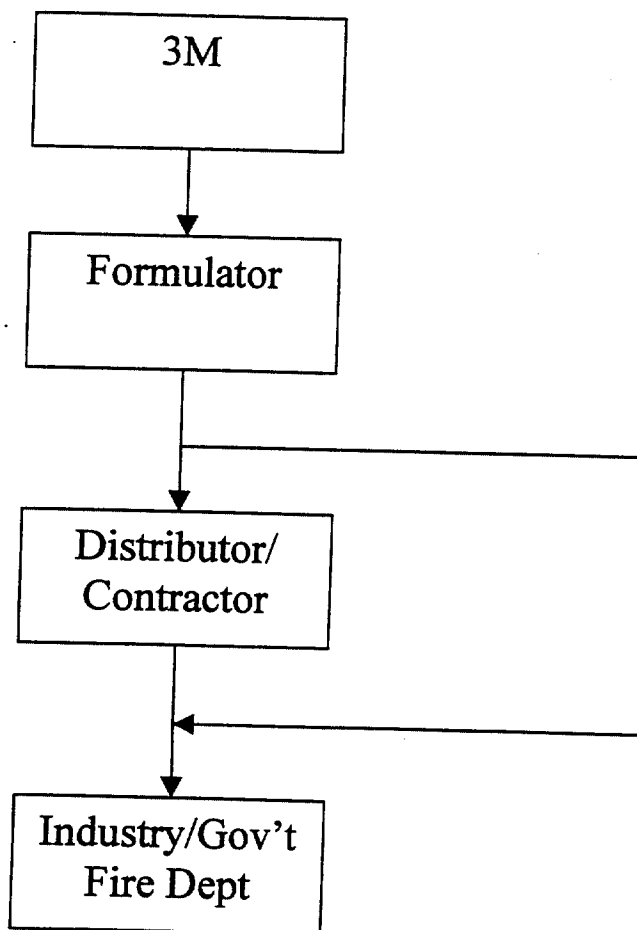


AFFF Foam Formulator Segment

Distribution Chain

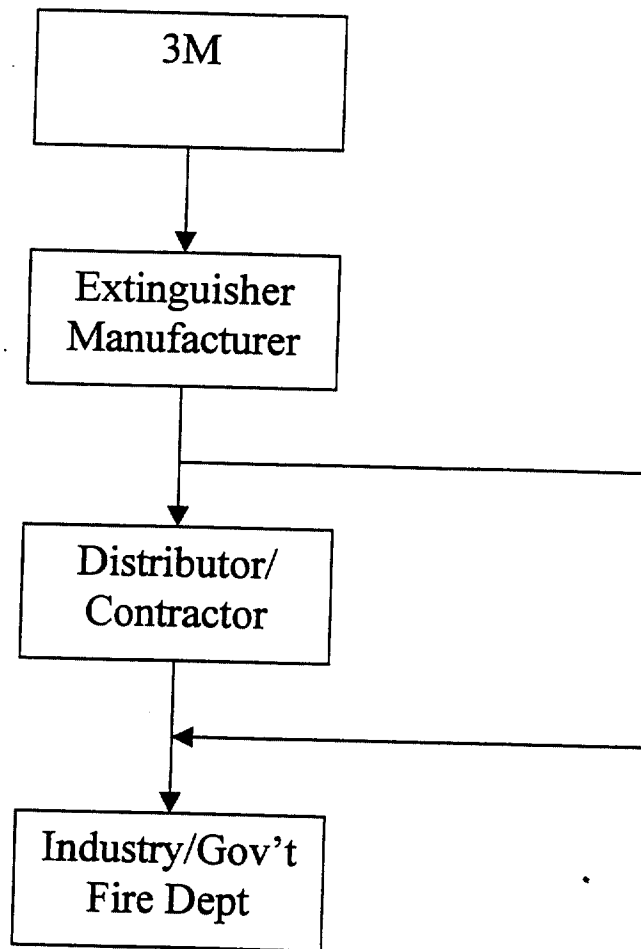
AFFF Foam Formulator Segment

Distribution Chain



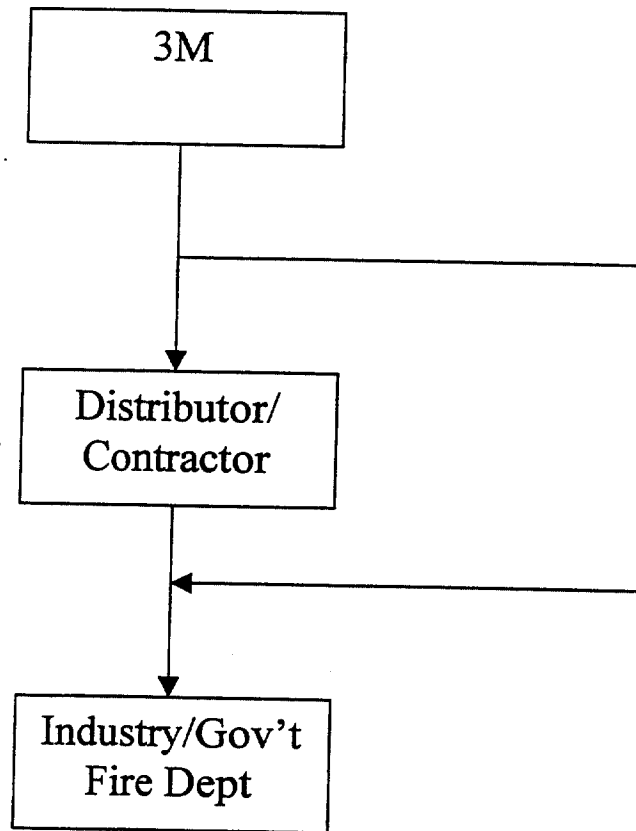
AFFF Fire Extinguisher Segment

Distribution Chain



AFFF Flammable Liquid Fire Fighting Segment

Distribution Chain

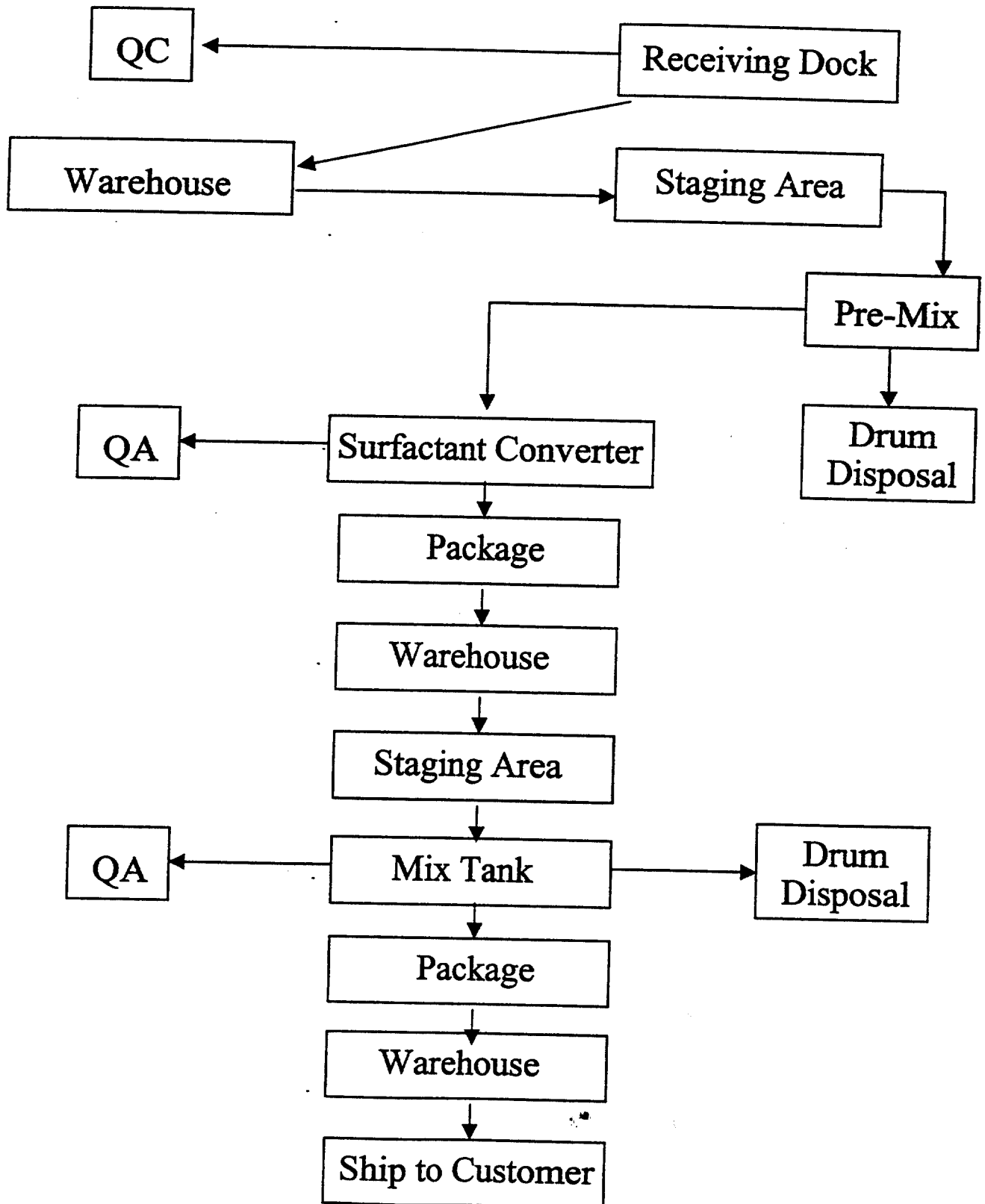


Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

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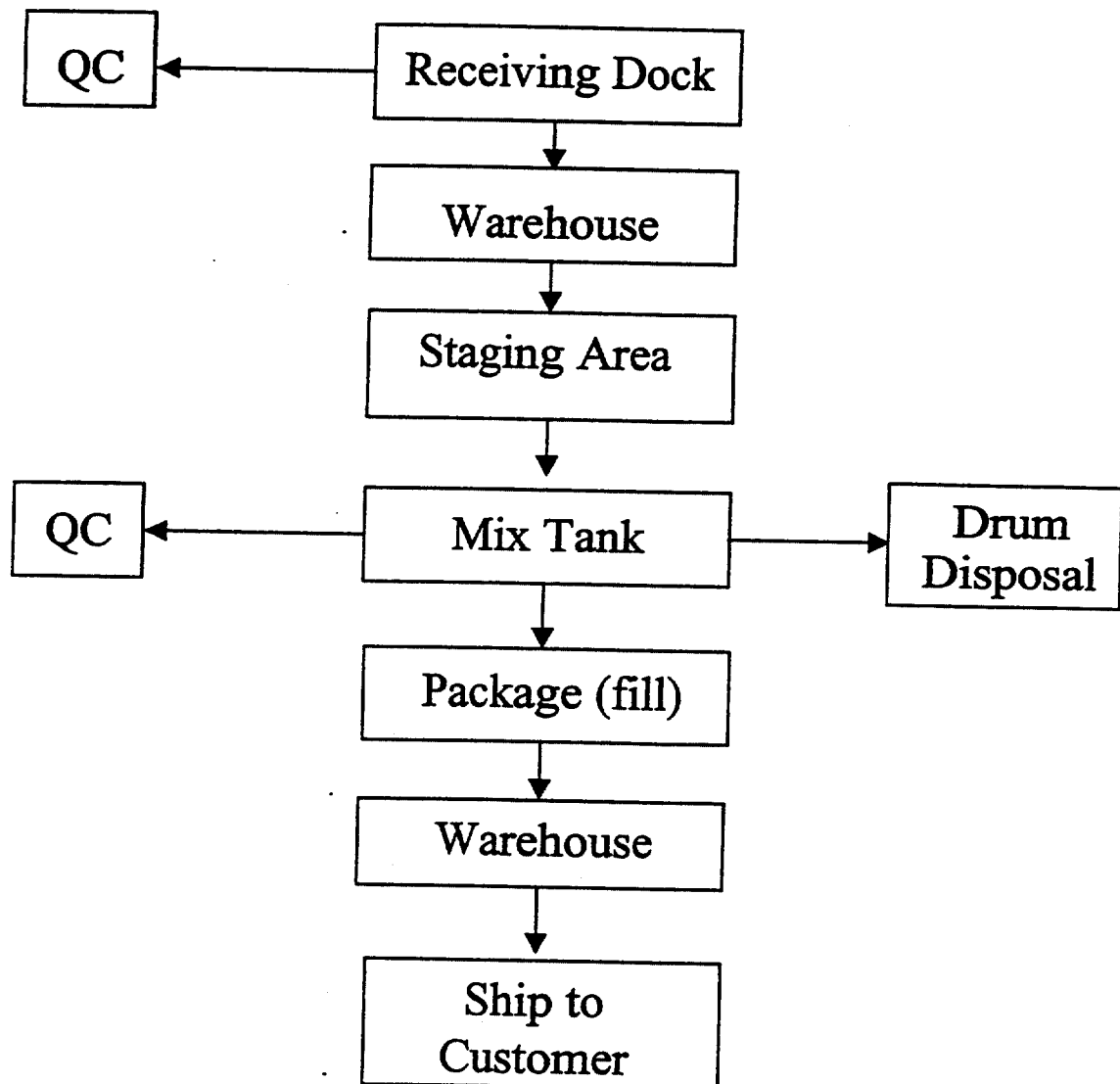
Points of Contact Fire-Fighting Foam Surfactant Converter



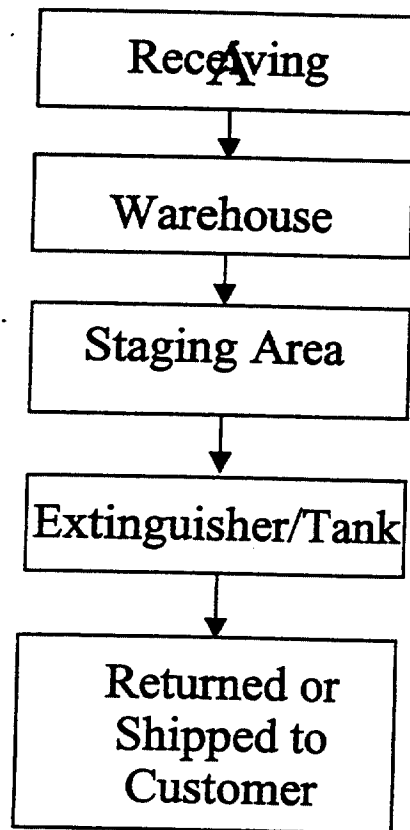
000225

Points of Contact

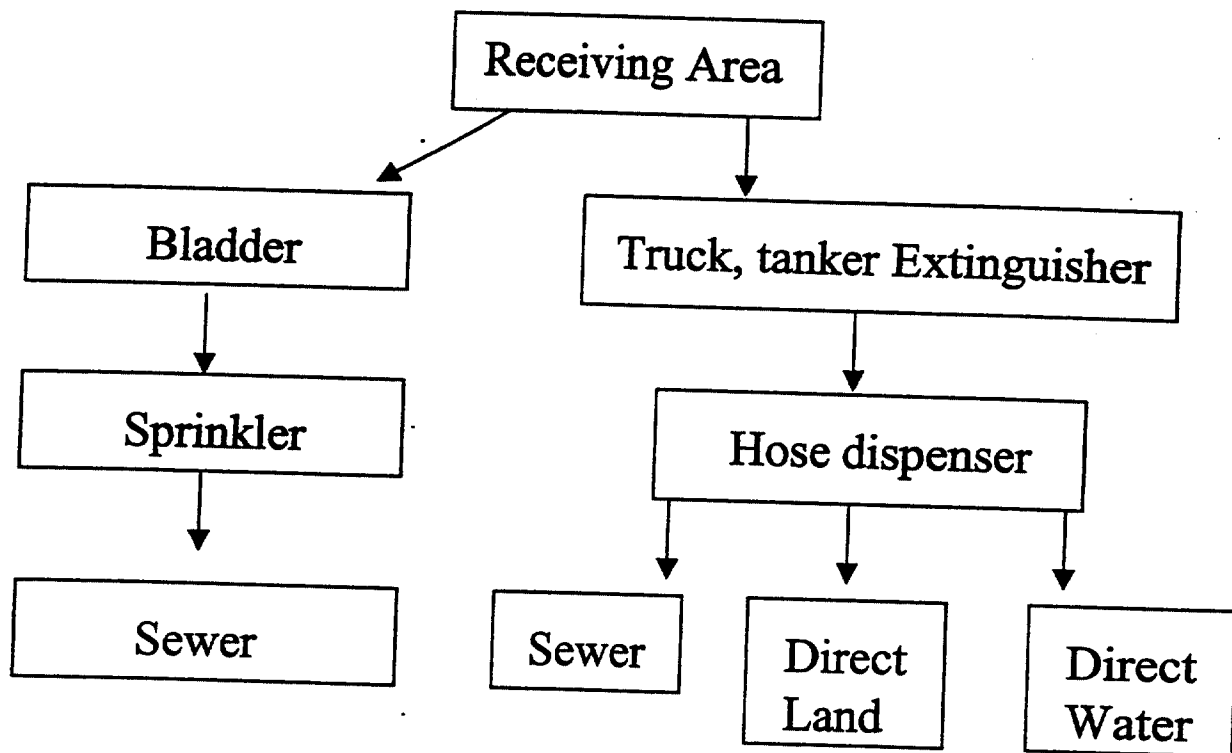
Formulator Fire-Fighting Foam



Points of Contact Fire-Fighting Foam Fire Extinguisher



**Points of Contact
Fire-Fighting Foam
End Use
All Products**



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3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information - Processed Raw Material

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times high medium low	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving		X			Low		X				X	Low incidence
QC		X			Low		X			X		Low incidence
Warehouse		X			Low		X				X	Low incidence
Staging		X			?		X			X		Low incidence
Pre-Mix?		X			?		X			X		Low incidence
Drum Disposal		X			Low		X			X		Low incidence
Surfactant Convertor		X			Low	X				X		Low incidence
QA		X			Low	X				X		Low incidence
Package		X			Low	X				X		Low incidence
Warehouse		X			Medium	X					X	Low incidence
Staging		X			Low	X				X		Low incidence
Mix Tank		X			Low	X				X		Low incidence
QA		X			Low	X					X	Low incidence
Package		X			Low	X				X		Low incidence
Warehouse		X			Low	X					X	Low incidence
Customer		X			Low	X					X	Low incidence

000230

FORMULATOR FF-7, FF-8

[illegible]

000231

End Use

[illegible]

000232

[illegible]

231

EXTINGUISHERS (fillers)

[illegible]

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use or fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

000235

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IM-1	Reactor						X						X	X	X (majority)	X	
IM-1 End Use	Fire-fighting							X							X	X	

000236

Product Volumes & Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
FF-14	Formulator of AFFF						X			X					X	X	
FF-15	Formulator of AFFF						X			X					X	X	
FF-16	Formulator of AFFF						X			X					X	X	
FF-17	Formulator of AFFF						X			X					X	X	
FF-18	Formulator of AFFF						X			X					X	X	
FF-19	Formulator of AFFF						X			X					X	X	
FF-20	Formulator of AFFF						X			X					X	X	
FF-21	Formulator of AFFF						X			X					X	X	
FF-14-FF-21	Fire fighting									X					X	X	
FF-1 -FF-13	Fire-fighting							X		X	X	X			X	X	
FF-4 FF-16	Filler of fire extinguishers									X					X		
	Fire-fighting									X	X	X			X	X	
	Fire-fighting									X	X	X			X	X	

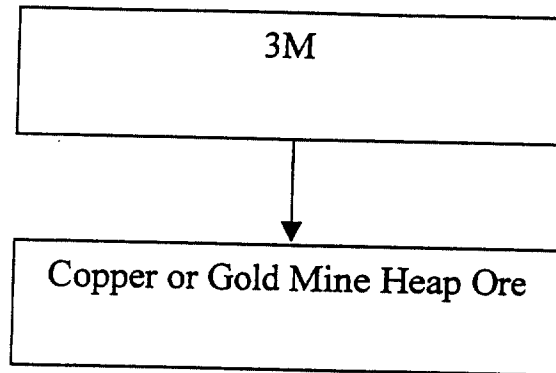
000237

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

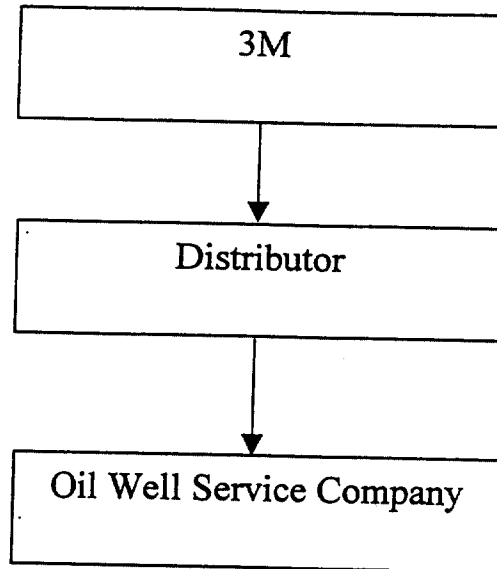
000238

Mining Distribution Chain



000239

Oil Distribution Chain



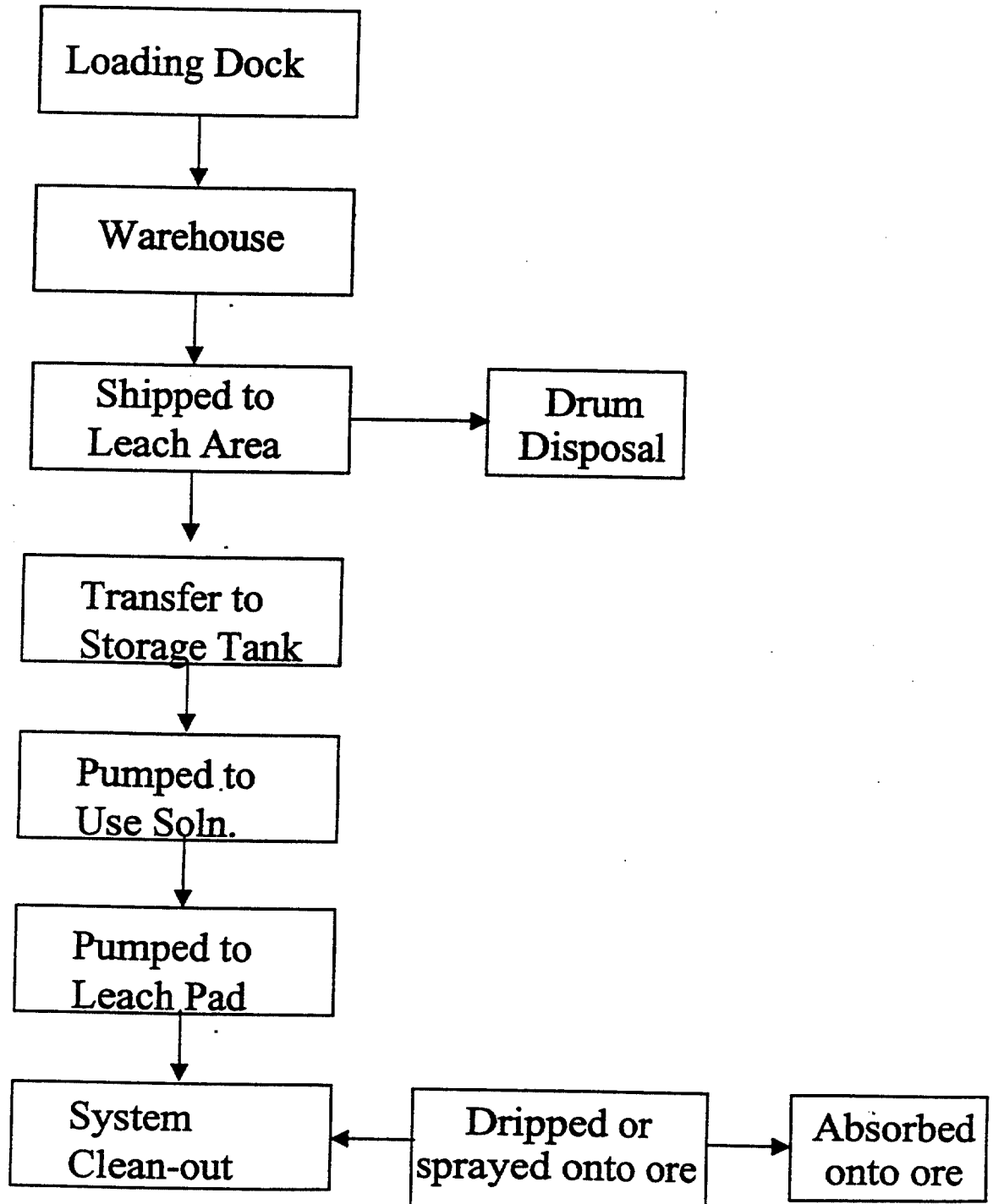
000240

Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

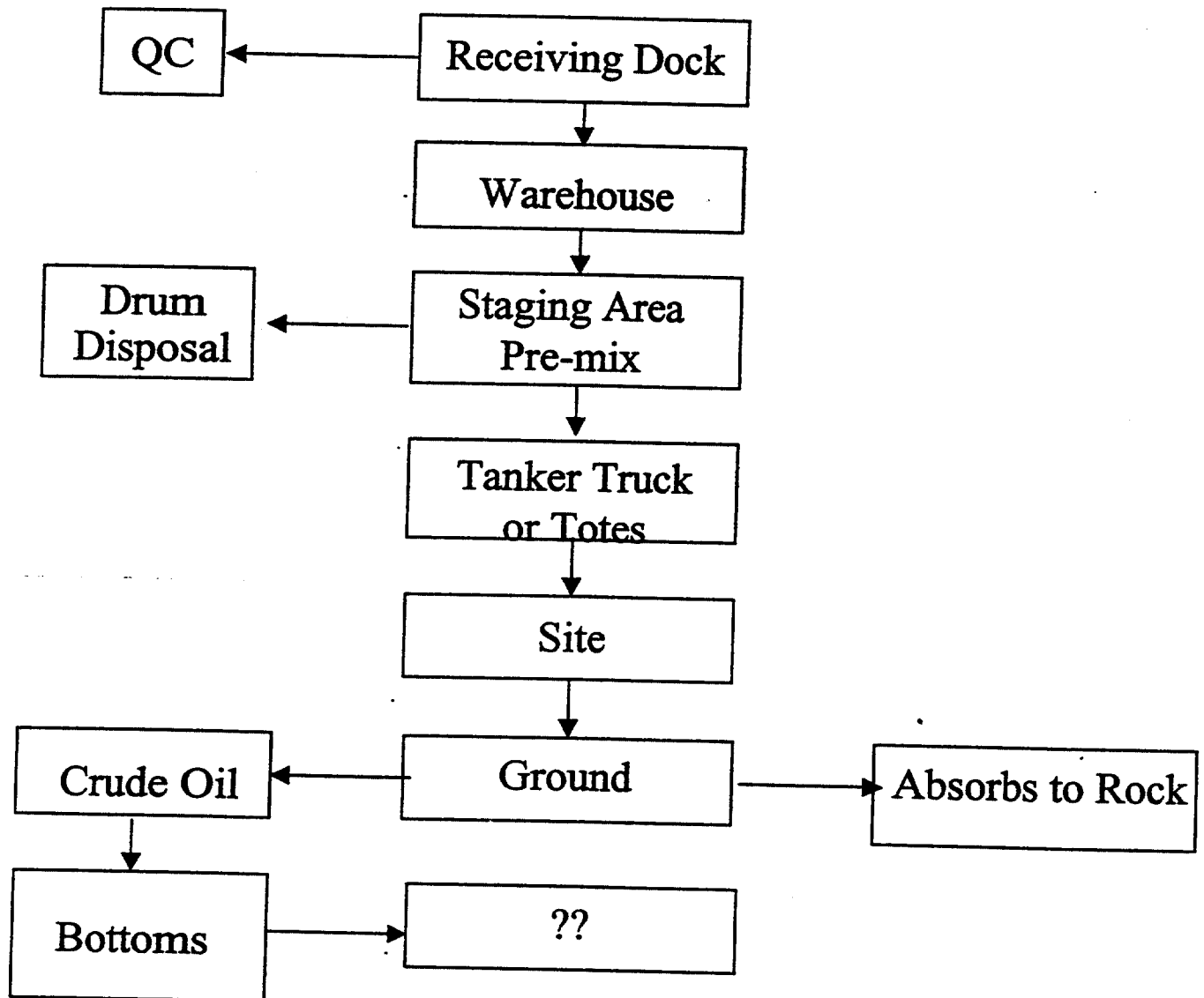
000241

Points of Contact Mining



000242

Points of Contact Oil Well Surfactants



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information MO-7, MO-6, MO-5, MO-3, MO-4

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving dock		X		1-2	Low	X					X	
QC		X		1-2	Low	X				X		Spills only. Technically qualified.
Warehouse		X		1-2	Low	X					X	Spills, leakers
Mix Tank		X		1-2	Medium	X					X	
Drum Disposal		X		1-2	Low	X				X		
Tanker				1-2	Low	X					X	
Site				1-2	Low	X					X	
Well				?	Low	X					X	
MO-3 Only Crude Oil				?	Low	X					X	
MO-3 Bottoms End Use				?			X			X		

243

000245

000245

000245

Exposure Information - MO-2, MO-1

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days Med.= 1-4 hrs., 50-100 days High= >4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Loading Dock				1-2	Low	X					X	
Warehouse (spills)				1-2	Low	X					X	
Leach Area		X		1-2	Low	X					X	
Storage Tank				1-2	Low	X					X	
Drum Disposal		X		1-2	Low	X				X		
Pumped to use solution				1-2	Low	X					X	
Pumped to leach pad				1-2	Low	X					X	
Dripped or sprayed onto ore					Low	X				X		
Clean-out				1-2	Low	X						

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

000247

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
MO-3	Formulator				Unknown		X			X					X		
MO-3	Oil Well Surfactant							X									
MO-3	Crude Oil								X								
MO-3	Bottoms						X										
MO-3	Copper heap leach mining							X?					?	X	?	?	
						X							Absorbs to rock				

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume FC Solids Sold in 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
MO-4							X			X					X		
MO-4								X									
													X	X	X		

Product Volumes and Use Patterns

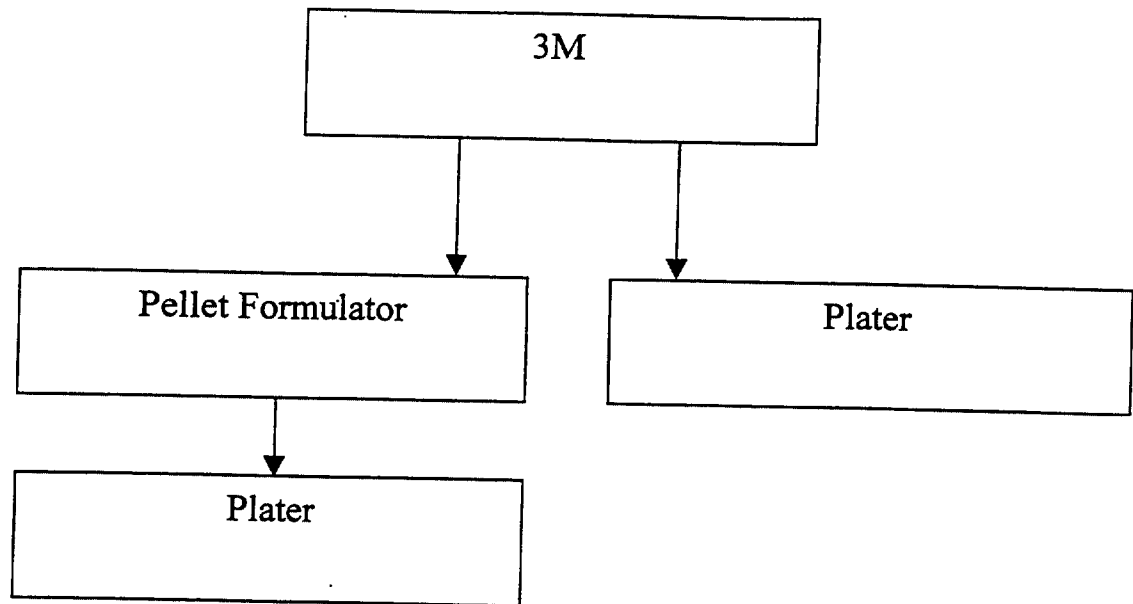
Product Code	Process or End Use	Volume FC Solids Sold in 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
MO-7	Formulator						X			X					X		
MO-7	Oil Well Surfactant							X					Absorbs to rock				

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
MO-5	Formulator						X			X					X		
MO-5	Oil Well Surfactant							X									
MO-6	Formulator						X			X				X			
MO-6	Oil Well Surfactant							X									
MO-1	Heap Leach						X			X							

Distribution Chain

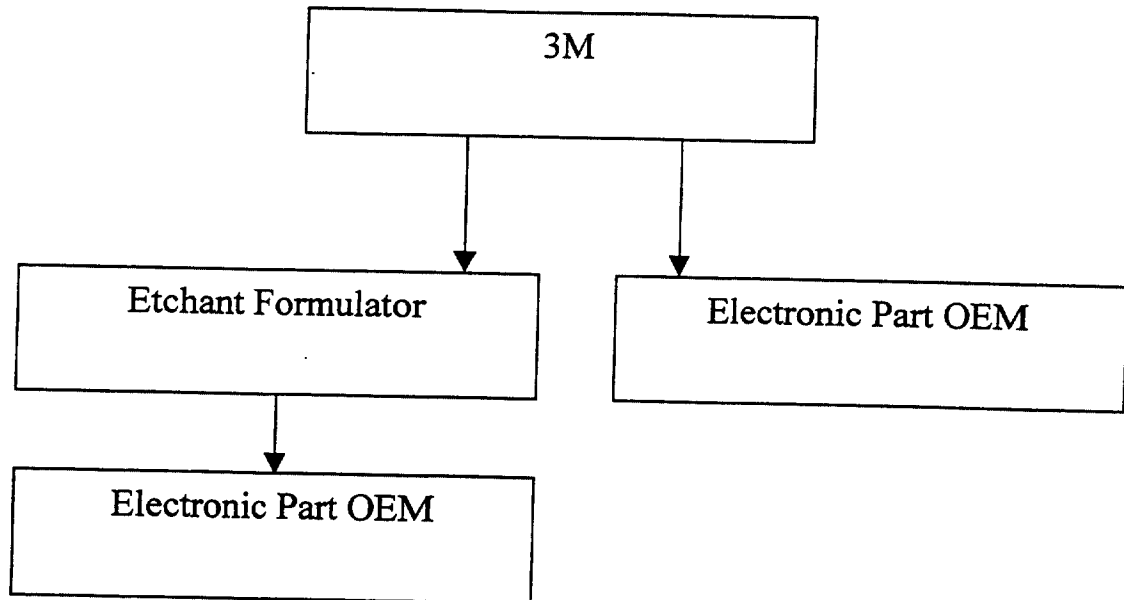
This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

Metal Plating Distribution Chain



000253

Electronic Etchant Distribution Chain



Points of Contact

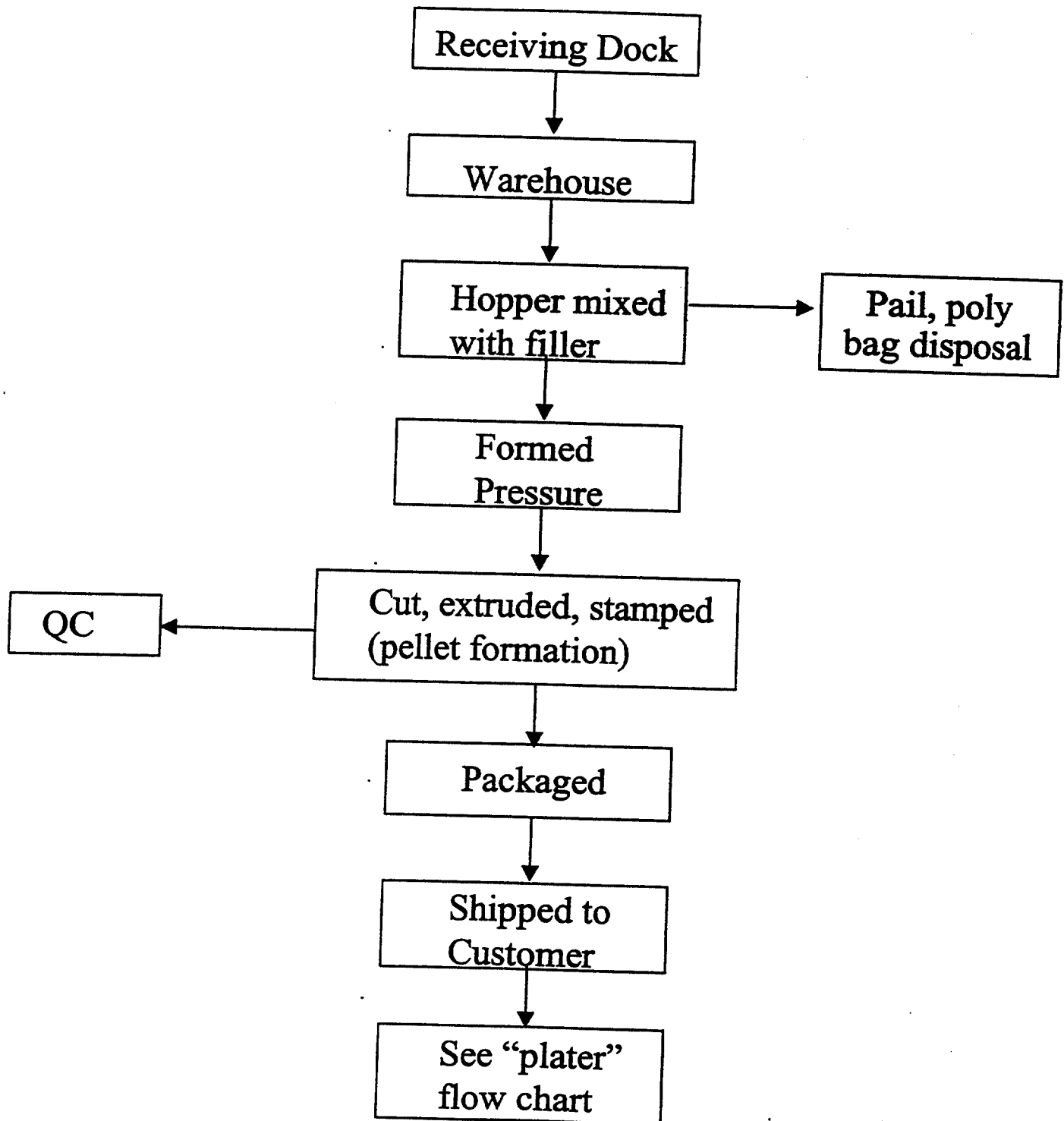
The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.



Points of Contact

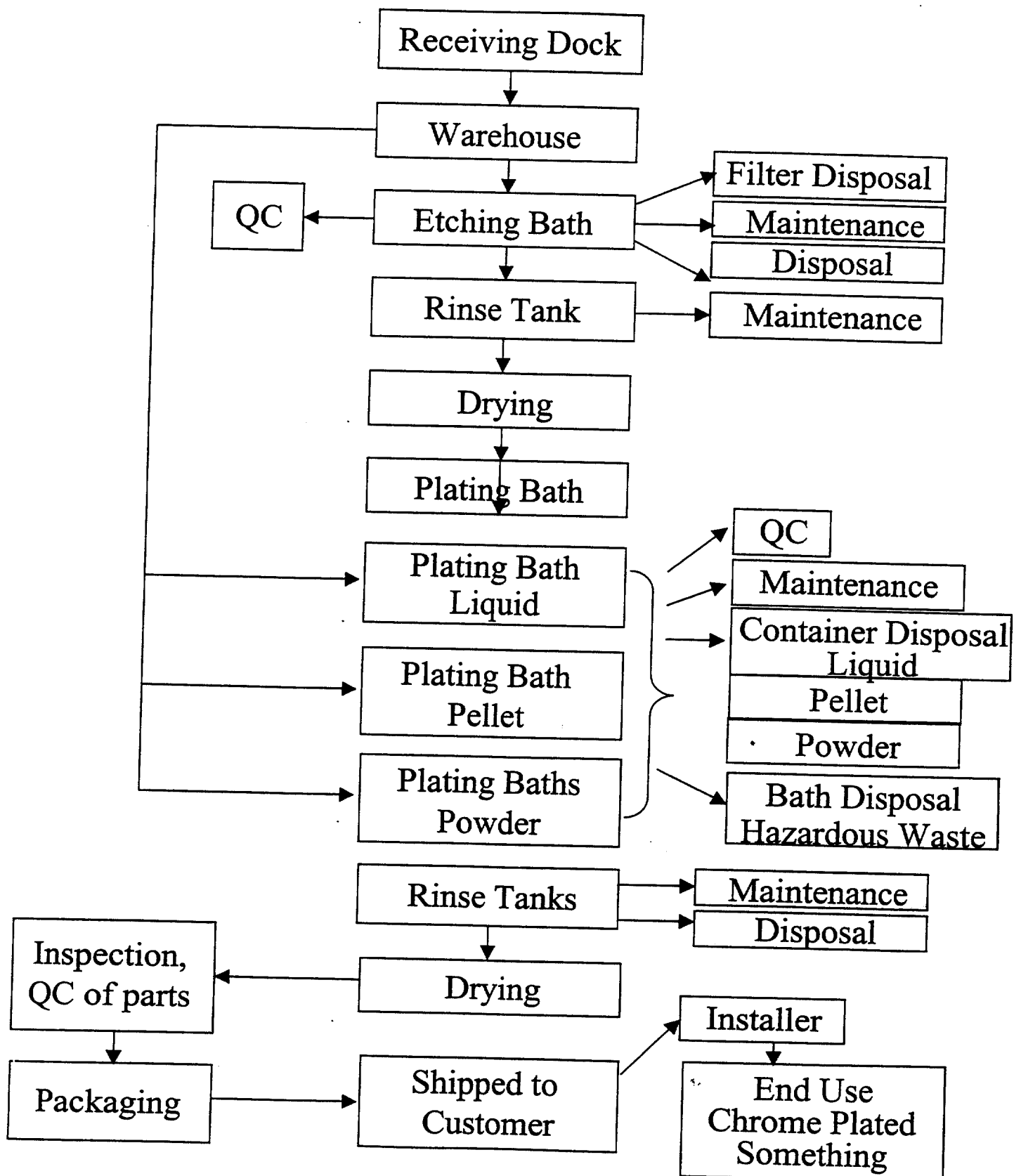
Metal, Plating

Pellet Maker/Formulator PE-1



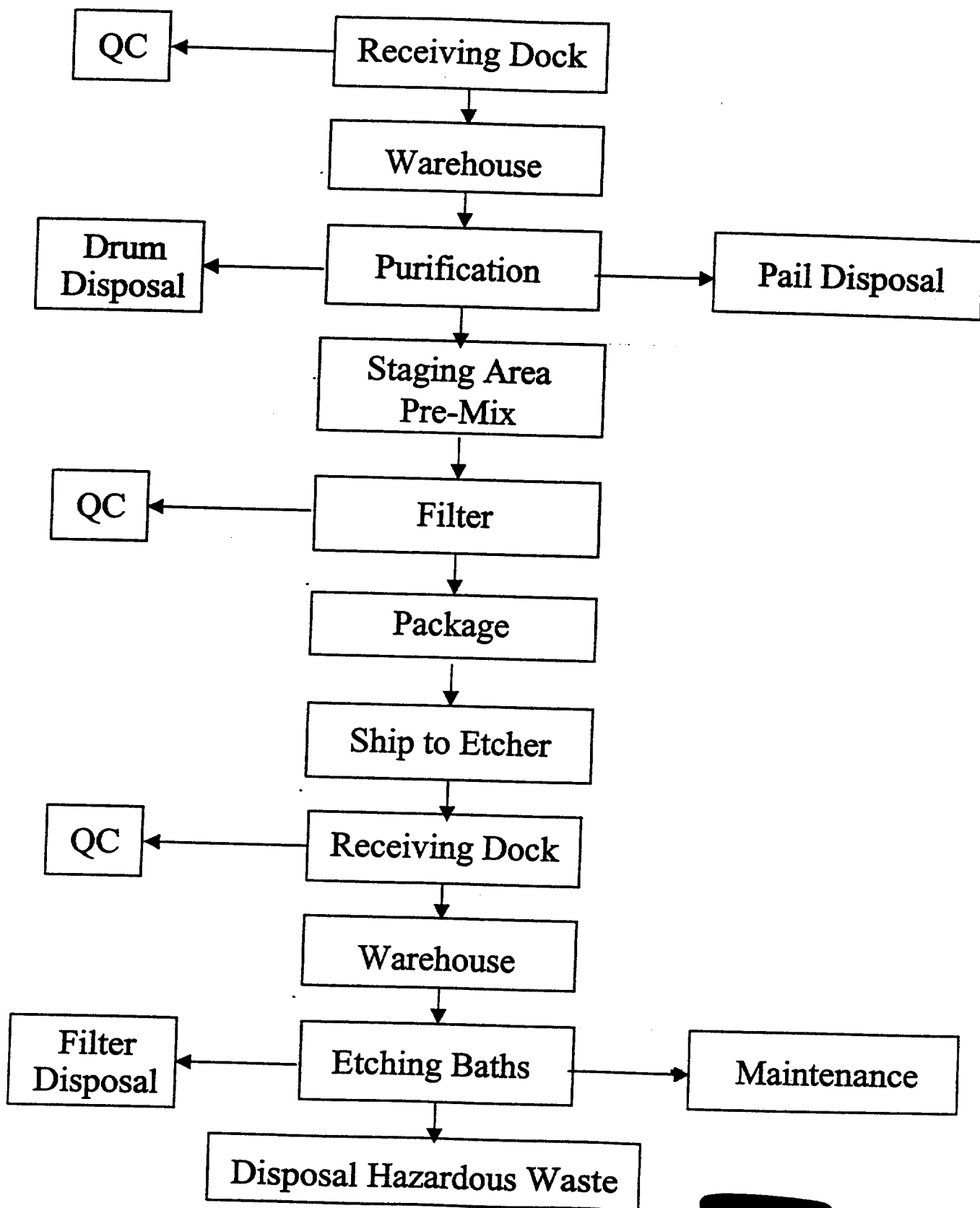
Points of Contact

Metal/Plastic Etching, Metal Plating



000257

Points of Contact Electronic Etching Baths PE-4, PE-3



000258

3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
PE-1	Metal Plating Bath						X			high	high	low	hazardous		X		used in
PE-1	etching bath						X			low	low	low	hazardous		X		conjunction with hazardous chemicals.
PE-1							X			high	high	low	hazardous	X	X		Used in conjunction with hazardous chemicals.

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
PE-3	Formulator/User. Metal Plating Bath						X			X							
PE-3	Formulator						X			X			hazardous		X		
	Etchants						X			X			hazardous	X			

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume FC Solids Sold in 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
PE-4	Formulator Electronic Etching Baths				n/a		X			X			hazardous	X	X		
PE-4	End Use Etcher						X						hazardous				Closed system, many rinses

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Exposure Information - Pellet Maker (Metal Plating Baths)

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving Dock		X	X	1-2?	Low		X				X	Low incidence of spills
Warehouse		X	X	1-2	Low		X				X	Low incidence of spills.
Hopper/Mixer		X	X	?	Medium		X			X		
Disposal		X	X	1-2	Low		X			X		
Pressure Forming		X	X	?	Medium		X			X		
Pellet Information		X		1-2?	Medium?		X			X		
QC		X		1-2	Low		X			X		Technically qualified
Packaging		X	X	?	Medium?		X			X		

000264

Exposure Information - Metal/Plastic Etching, Metal Plating

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving Dock												
Liquid		X		1-2	Low	X						Incidence low (spills)
Powder		X	X		Low		X				X	
Pellet		X	X		Low		X				X	
Warehouse				1-2								
Liquid		X	X		Low	X						
Powder		X	X		Low		X				X	Incidence low (spills, leakers)
Pellet		X	X		Low		X				X	
Plating, Etching Bath				?	Low							
Liquid		X			Low	X						
Powder		X	X		Low		X			X		Corrosive acids are present
Pellet		X	X		Low		X			X		
QC (bath)		X		1-2	Low	X				X		
Maintenance		X		1-2	Low	X				X		Technically trained
Disposal of Container				1-2								
Liquid		X			Low	X				X		
Powder		X	X		Low		X			X		
Pellet		X	X		Low		X			X		

Exposure Information - Metal/Plastic Etching, Metal Plating

[illegible]

000266

Exposure Information - Electronic Etching Baths

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Formulator												
Receiving Dock		X		1-2?	Low	X						
QC		X		1-2?	Low	X				X		Low incidence of spills. Technically qualified
Warehouse		X		1-2?	Low	X						Low incidence of spills/leakers
Purification		X		?	Medium?	X					X	
QC		X		1-2?	Low	X					X	
Pre-mix		X		1-2?	Low	X						Technically qualified
Pail Disposal		X		1-2?	Low	X				X		
Filter		X		?	Medium	X				X		
QC		X		?	Medium	X					X	
Package		X			Medium	X					X	
Ship to Etcher											X	

000267

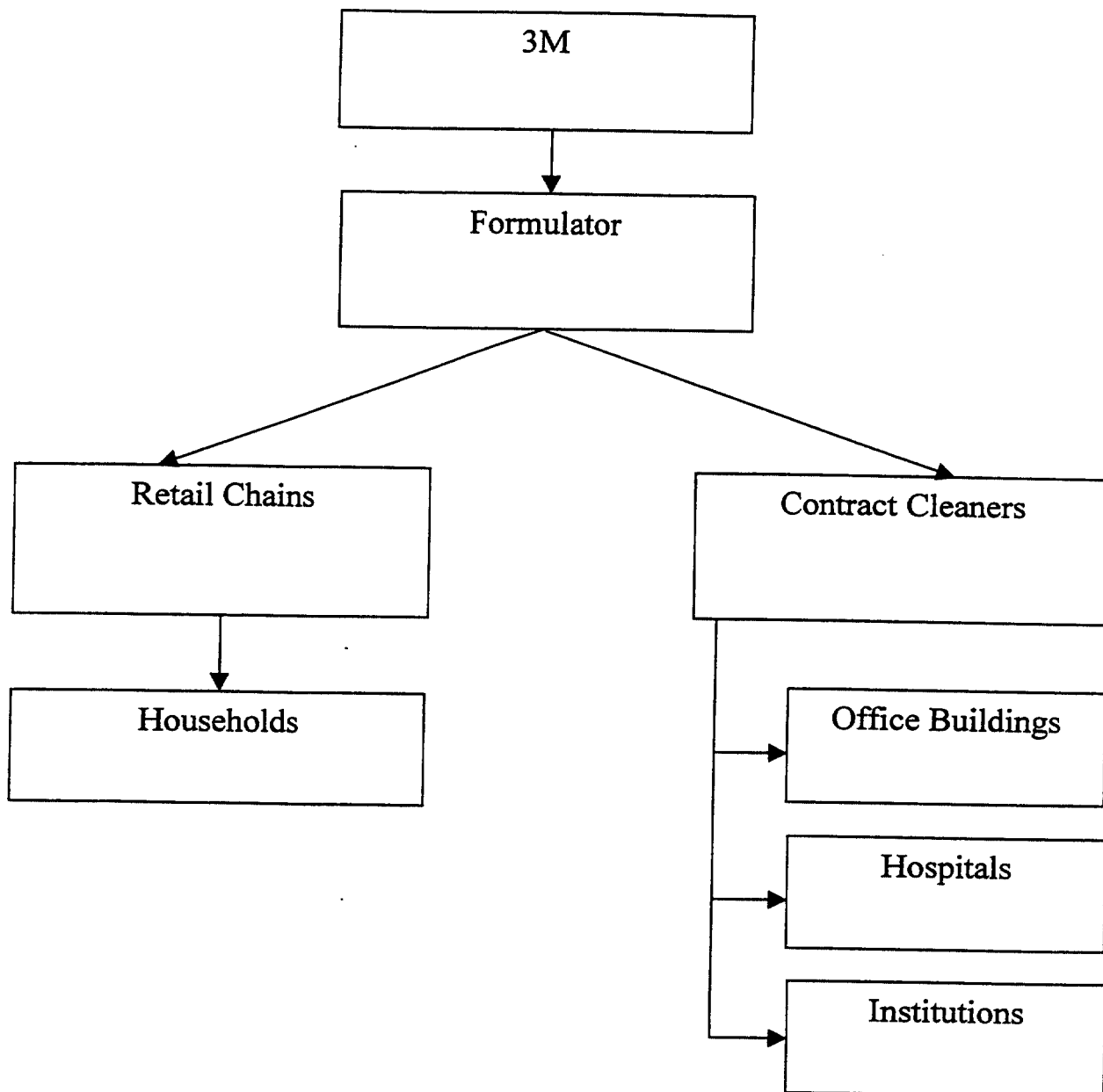
Exposure Information - Electronic Etching Baths

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Etcher												
Receiving Dock		X		1-2?	Low	X					X	Low incidence of spills.
QC		X		1-2?	Low	X				X		Technically qualified
Warehouse		X		1-2?	Low	X					X	Low incidence of spills/leakers
Purification		X		?	Medium?	X					X	
QC		X		1-2?	Low	X						Technically qualified
Pre-mix		X		1-2?	Low	X				X		
Pail Disposal		X		1-2?	Low	X				X		
Filter		X		?	Medium	X					X	
QC		X		?	Medium	X					X	
Package		X			Medium	X					X	
Ship to Etcher												

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

Household Additive Distribution Chain

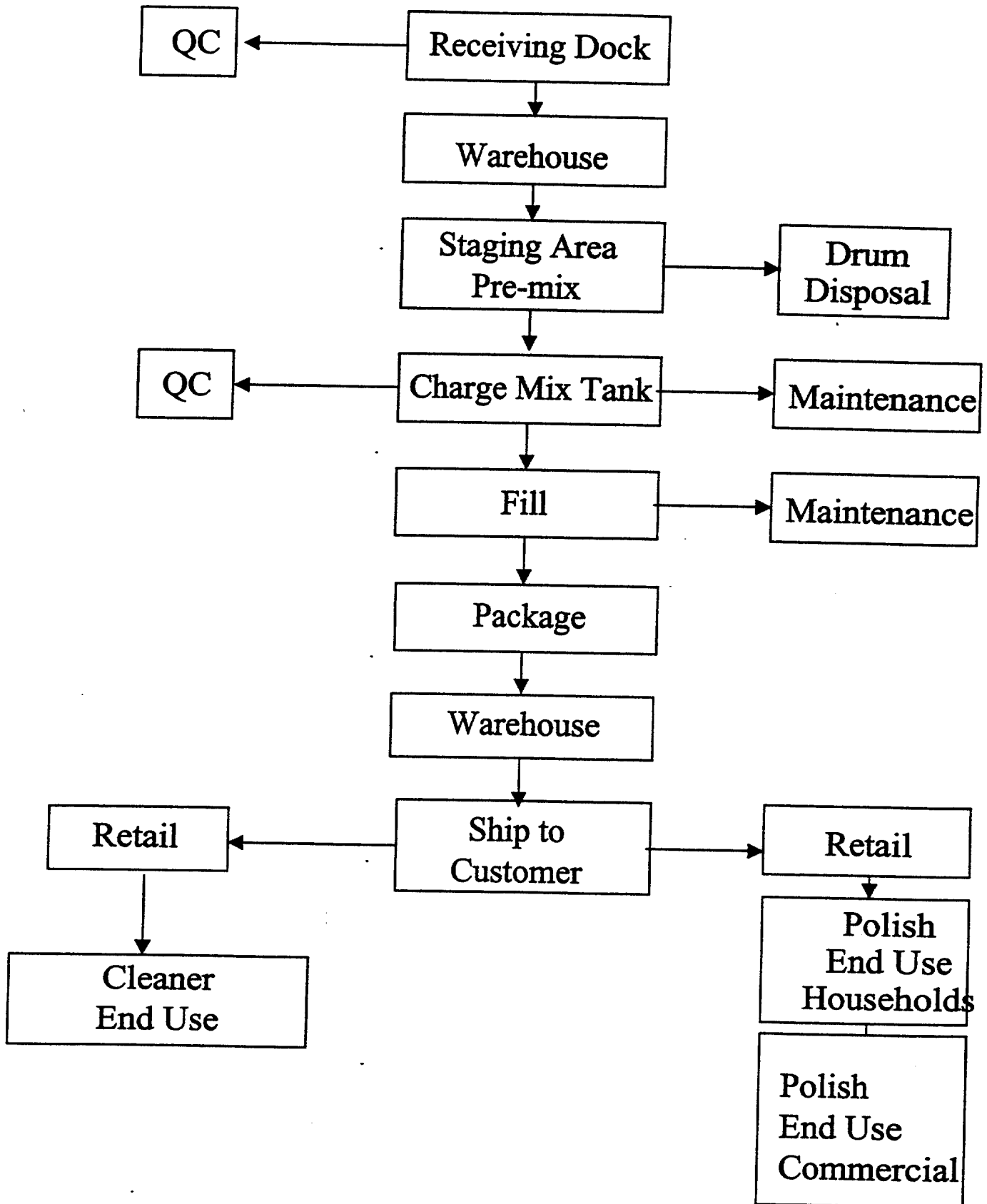


Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

Points of Contact Formulator

Household Additives (cleaners, polish,)



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information - Household Additives

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving Spills		X		Not Known and variable	Low	X						Infrequent
QC		X			Low	X						Technically Qualified
Warehouse (spills)		X			Low	X						Infrequent
Staging (spills)		X			Low	X						Infrequent
Predilution		X			Medium	X						
Container Disposal		X			Low	X						
Mixing Tank		X			Medium	X						
Maintenance		X			Low	X						
QC		X			Low	X						
Filling		X			Medium	X						Technically Qualified
Packaging (leakers)		X			Low	X						
Shipping (leakers)		X			Low	X						Infrequent
												Infrequent

000274

Exposure Information - Household Additives

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Cleaner-Users												
Household	X?	X	X?		Low	X		X				
Janitorial (in-house)	X?	X	X?		Medium	X		X				
Contract Services	X?	X	X?		High	X		X				Fewer/greater freq.
	?=Unsure of particle size							X				Great freq.
Users												
Household												
Applier/Stripper		X			Low	X						
Dry	X?	X	?		High		dust					
Janitorial (in-house)												
Applier/Stripper		X	X		Medium	X						
Maint. (buffing)	X?	X	X?		Medium		dust					More freq. Than house
Dry	X?	X	?				dust					
Commercial Serv.												
applier/stripper		X	Nil		High	X						
Maint. (buffing)	X?	X	X?		High		dust					Sim. To janito. More freq.
Dry	X?	X	?				dust					

000275

[illegible]

274

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use or fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

000277

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
HA-1	Formulator of cleaner						X			X			X	X	X		
HA-1	Commercial Cleaner							X		X			X	X	X		Majority of use is commercial cleaners.
HA-1	Formulator of commercial floor polish						X			X			X		X		
HA-1	Applier/Stripper							X		X	x		X		X		Major use is commercial
HA-1	polish							X		X	X	X	X	X	X		

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
HA-2	Formulator of cleaner						X			X			X	X	X		
HA-2	End use cleaner							X	X	X	X	X	X	X	X		
HA-2	Formulator of polish						X			X	low				X		
HA-2	polish applicator/stripper							X		X	X		X	X	X		
HA-2	polish End Use							X		X		X	X	X	X		

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold in 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
HA-3	formulator						X			X					X		
HA-3	End use cleaner								X	X					X		

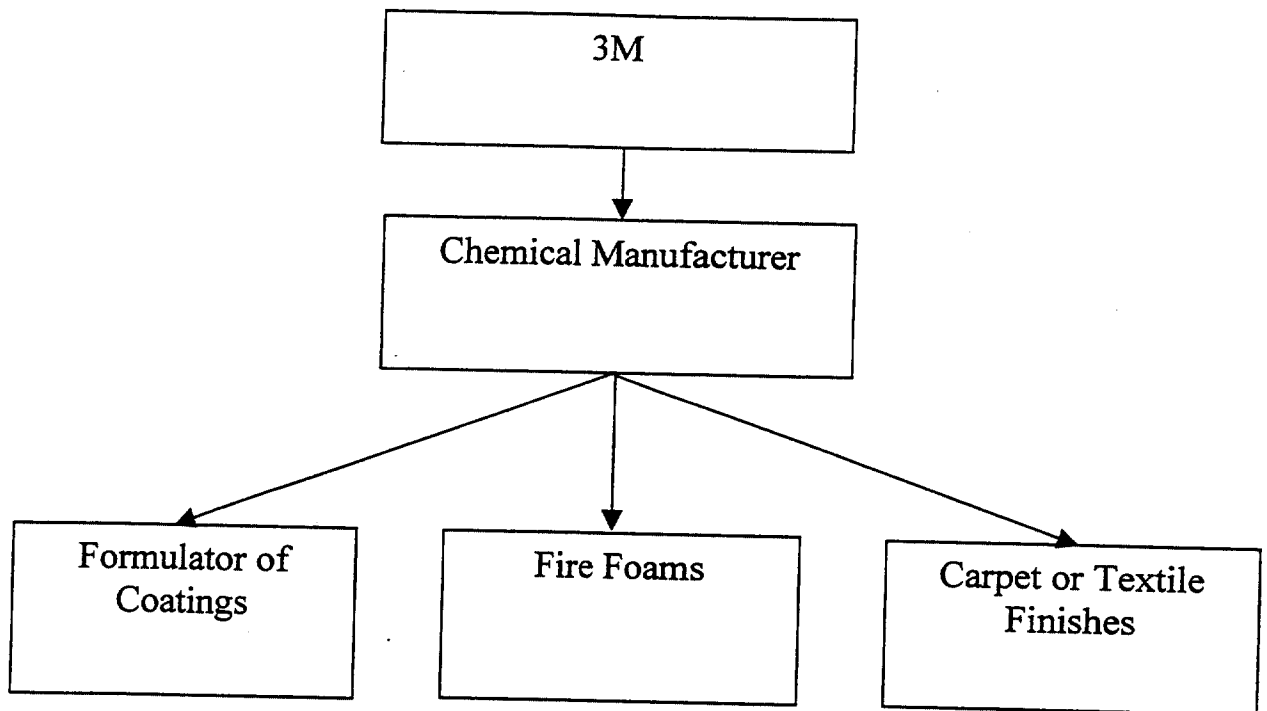
Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
HA-6	Formulator of polish				?			X		low	low	low	X	x	X		
HA-6	polish applicer/stripper										Household-low Janitorial						
HA-6	polish end use						X	X		high	Commercial Service-medium	low	X	X	X		
								X	X	high	low/medium	medium	X	X	X		

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

000282

Intermediates Distribution Chain



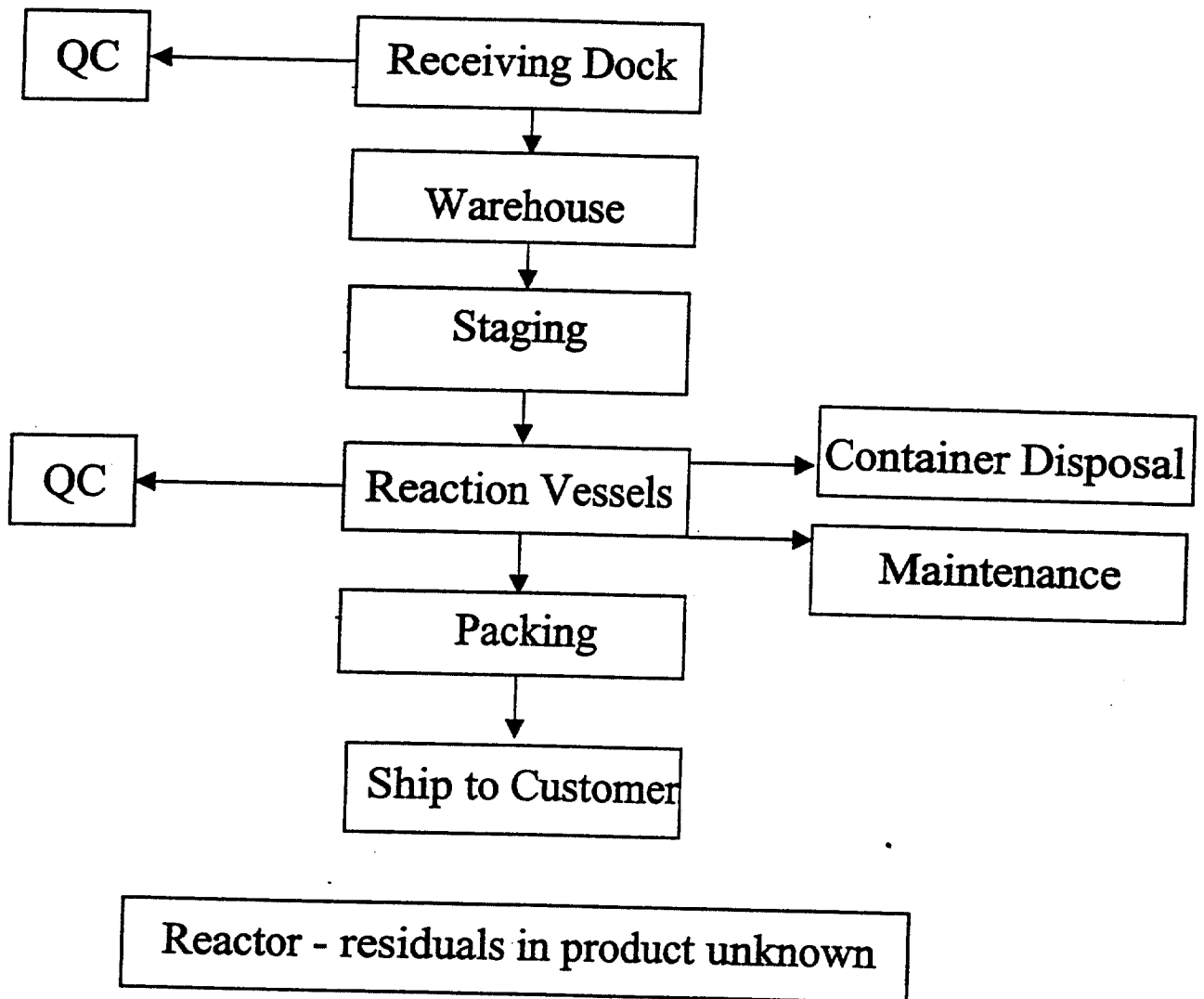
000283

Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

000284

Points of Contact Reactor Intermediates



Customer is a formulator that uses surfactants for end uses similar to 3M, including surface treatment like

3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

000286

Exposure Information - Intermediates

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days Med.= 1-4 hrs, 50-100 days High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Reactor												
Receiving		X		1-2	Low	X	X				X	
QC		X		1-2	Low	X	X					Low incidence of spills, leakers
Warehouse		X		1-2	Low	X	X					Technically qualified
Staging		X		?	Low?	X	X					Low incidence of spills, leakers
Reaction Vessels		X	X?	?	Low?	X	X					
Container disposal				?	Low?	X	X					
Maintenance		X		1-2	Low	X						
QC				1-2	Low	X						Technically qualified
Package		X		?	Low	X						
Ship to Customer		X			Low	X						Low incidence of spills

Formulator - similar to formulators of household additives, AFFF, oil well surfactants, etc.

End use - similar to household additives, AFFF, oil well surfactants, etc.

000287

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns .

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IM-1	Reactor Chemical Synthesis				n/a		X			X			hazardous		X		
IM-1	Formulator of new molecule						X			X			hazardous		X		
IM-1	End use							X	X	X			X	X	X		

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IM-2	Reactor Formulator Chemical Synthesis																
	Formulator of new molecule						X			X	X		hazardous		X		
							X			X					X		
	End use							X									

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IM-3	Chemical Synthesis reacted into polymer						X			high	med?	low	hazardous		X		
IM-4	Chemical Synthesis									?	?	?	?		?		
IM-5	Chemical Synthesis									?	?	?	?		?		
IM-3 IM-4 IM-5	Formulator of new molecule			?	?		X	X		high	low	low			X		
	End use new molecule		?	?	?			X	X	?	?	?	?				

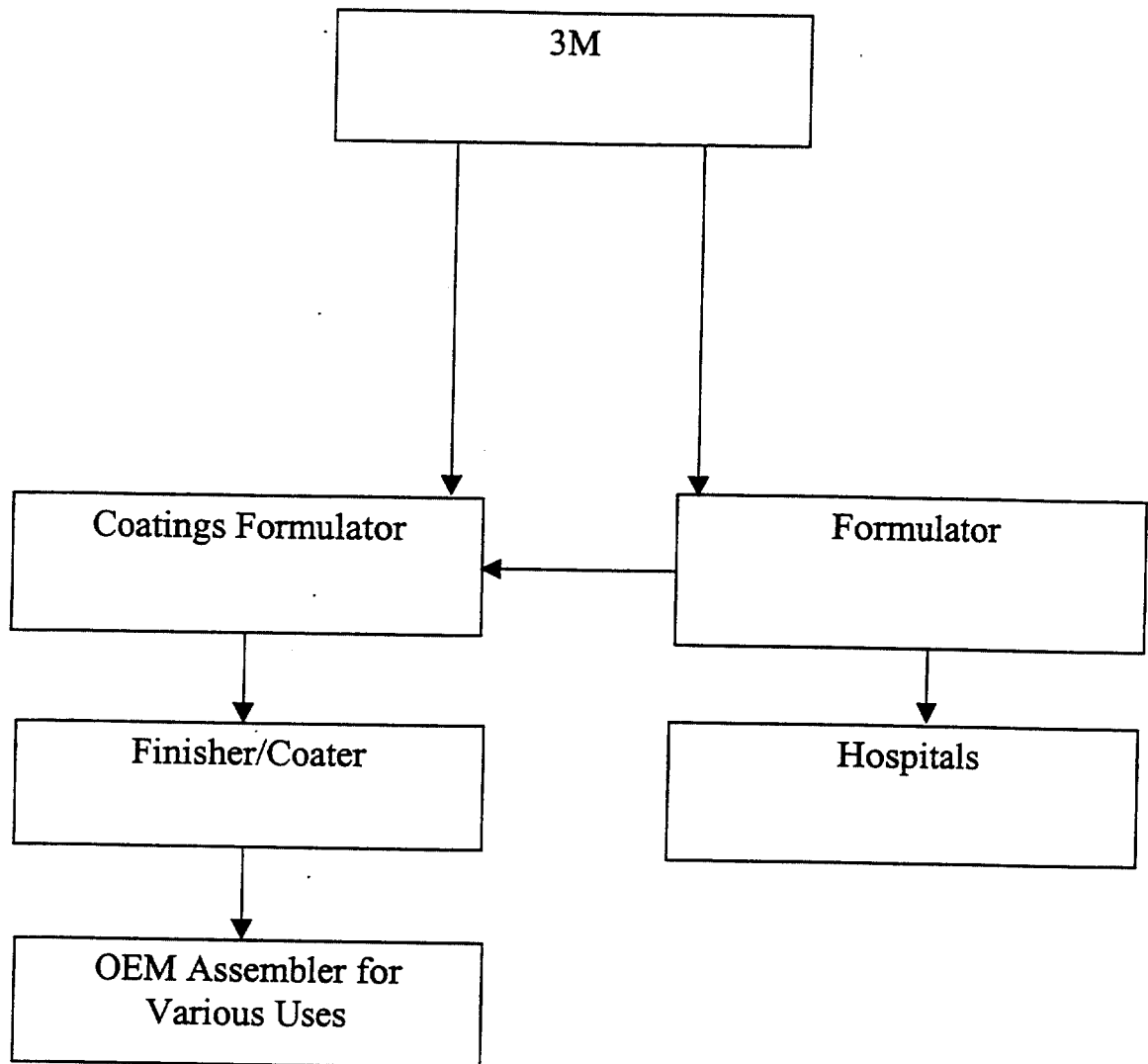
000291

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

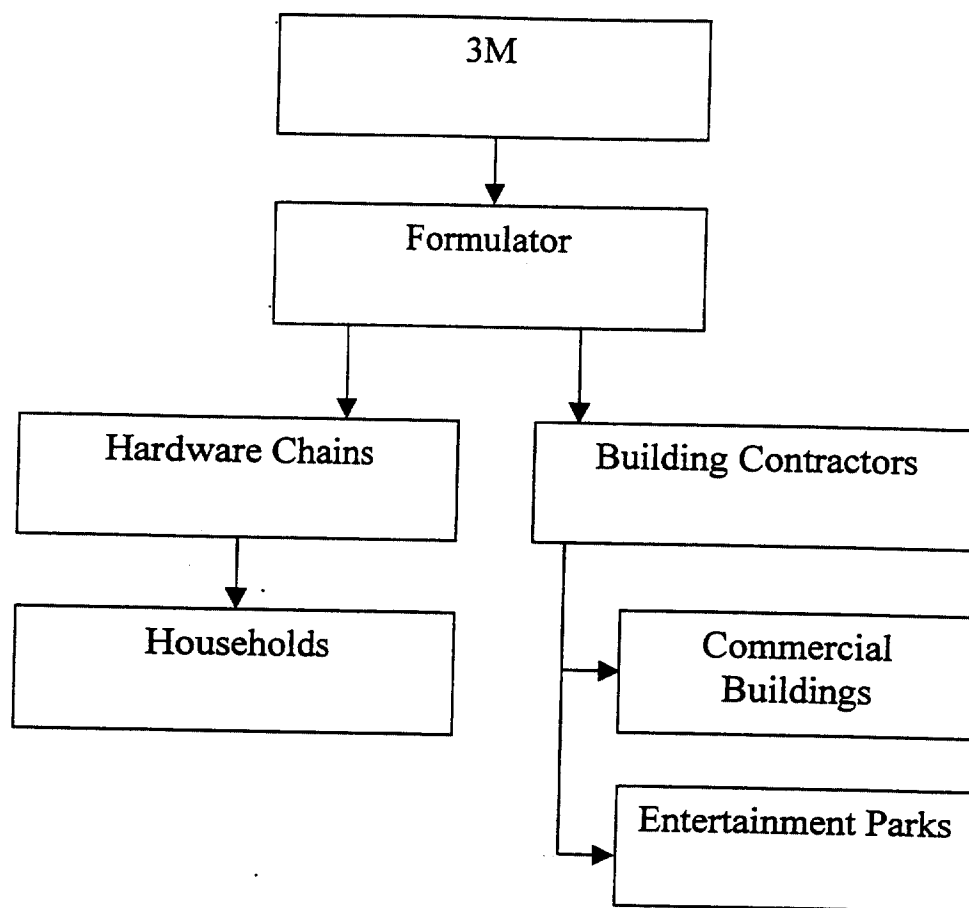
000292

Coating Additives Distribution Chain



000293

Coatings Distribution Chain



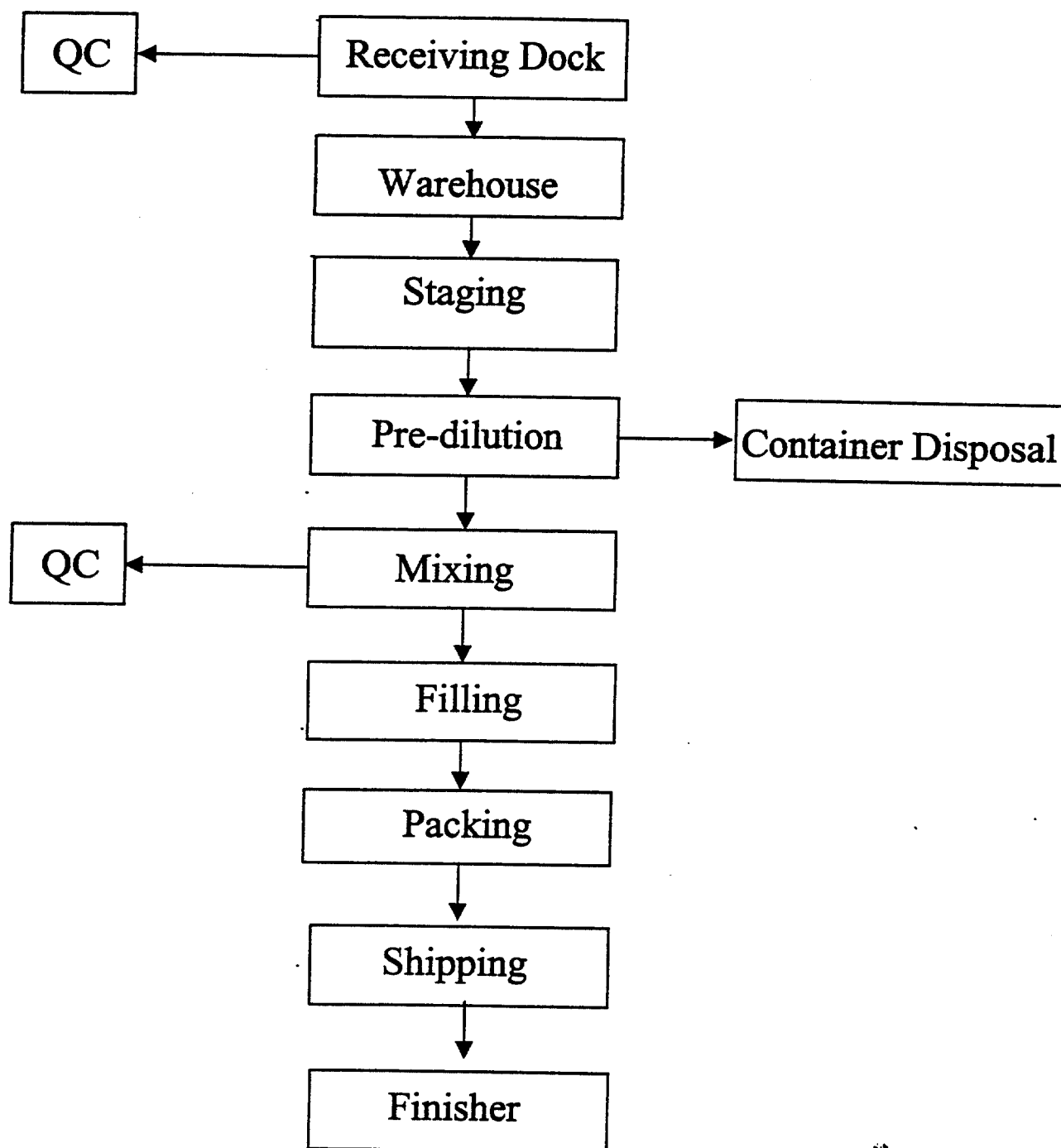
000294

Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

000295

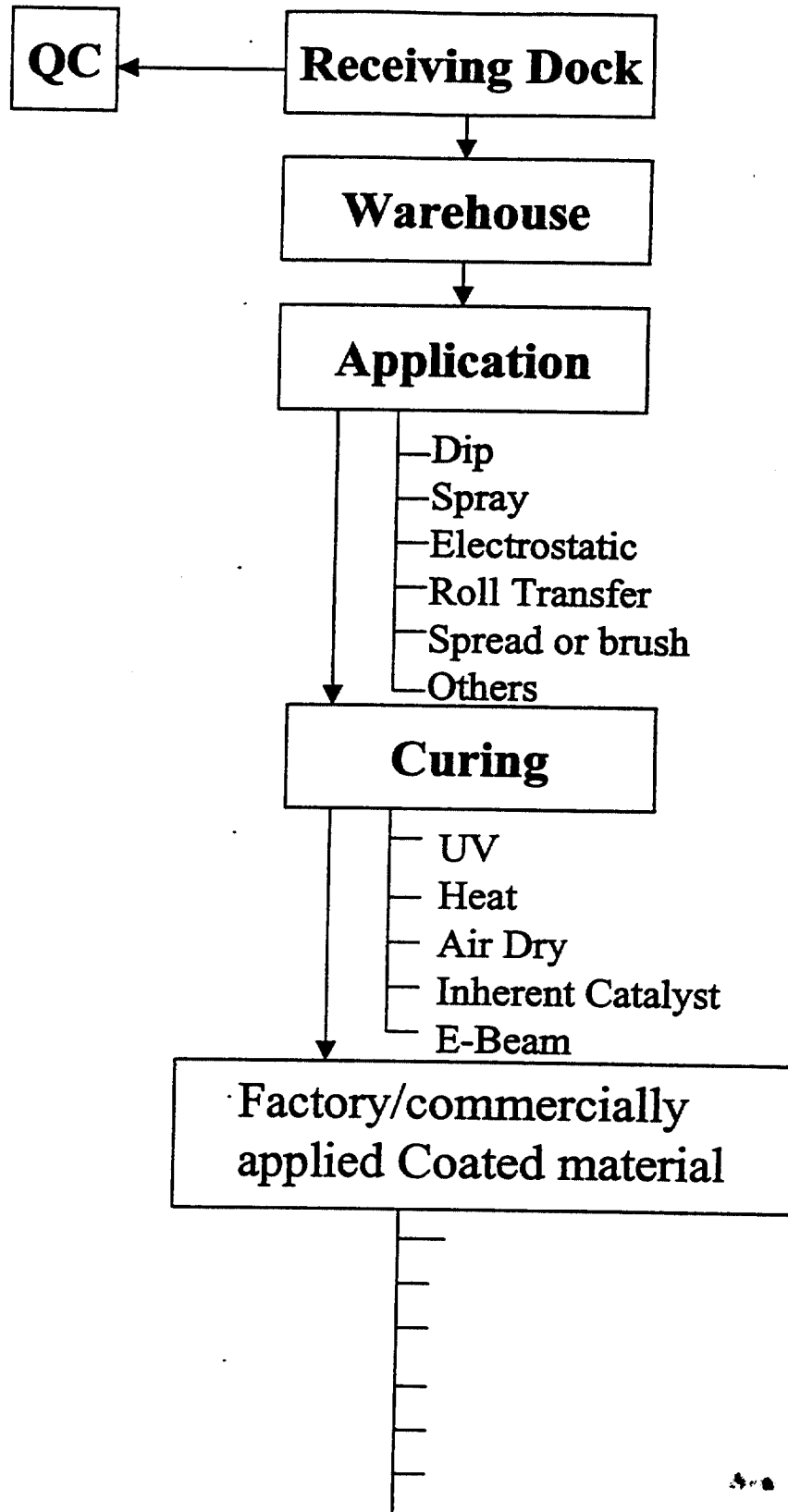
Points of Contact Coating Additives and Inks



000296

Points of Contact

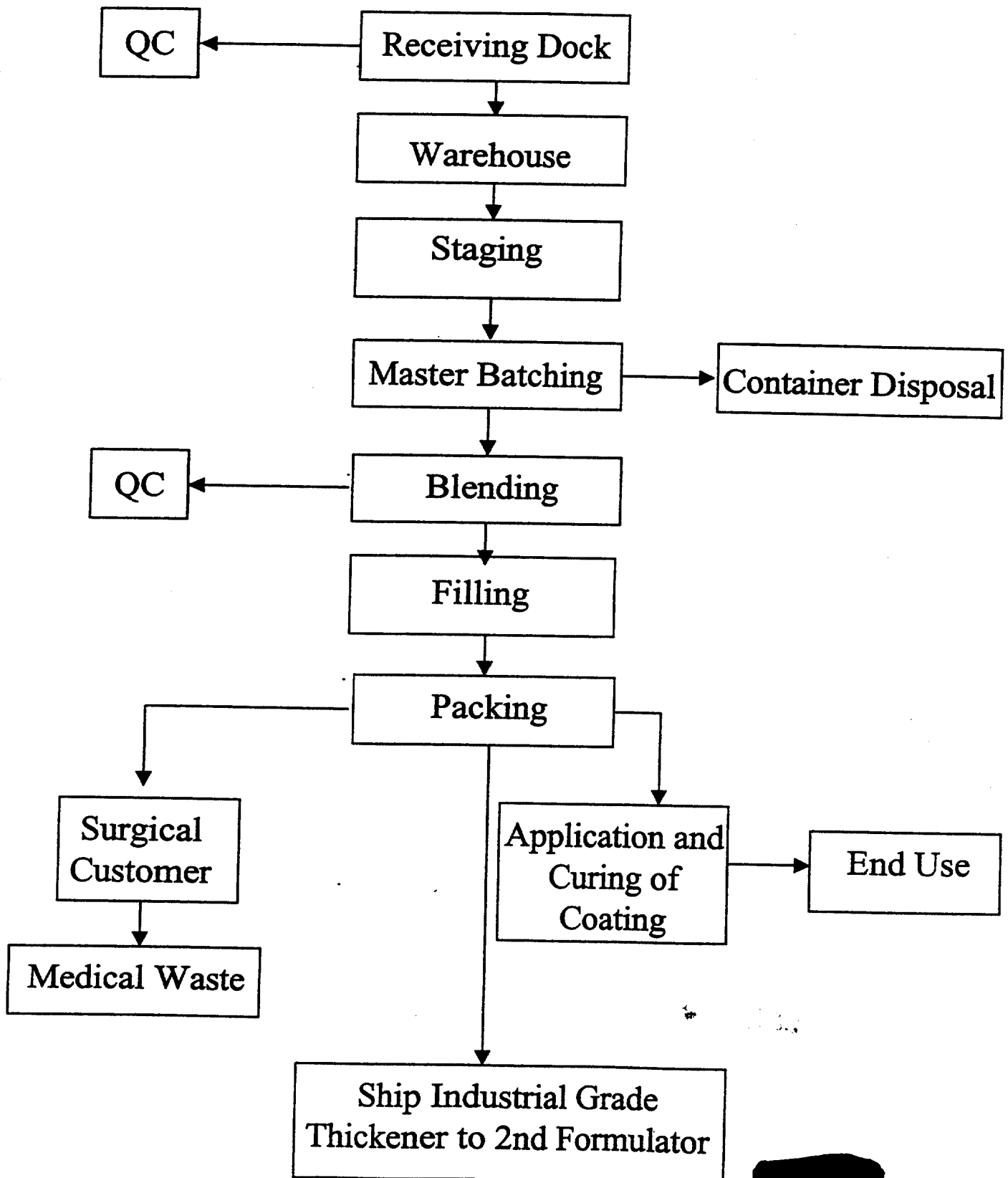
Finisher/End Use - Coating Additives and Inks



000297

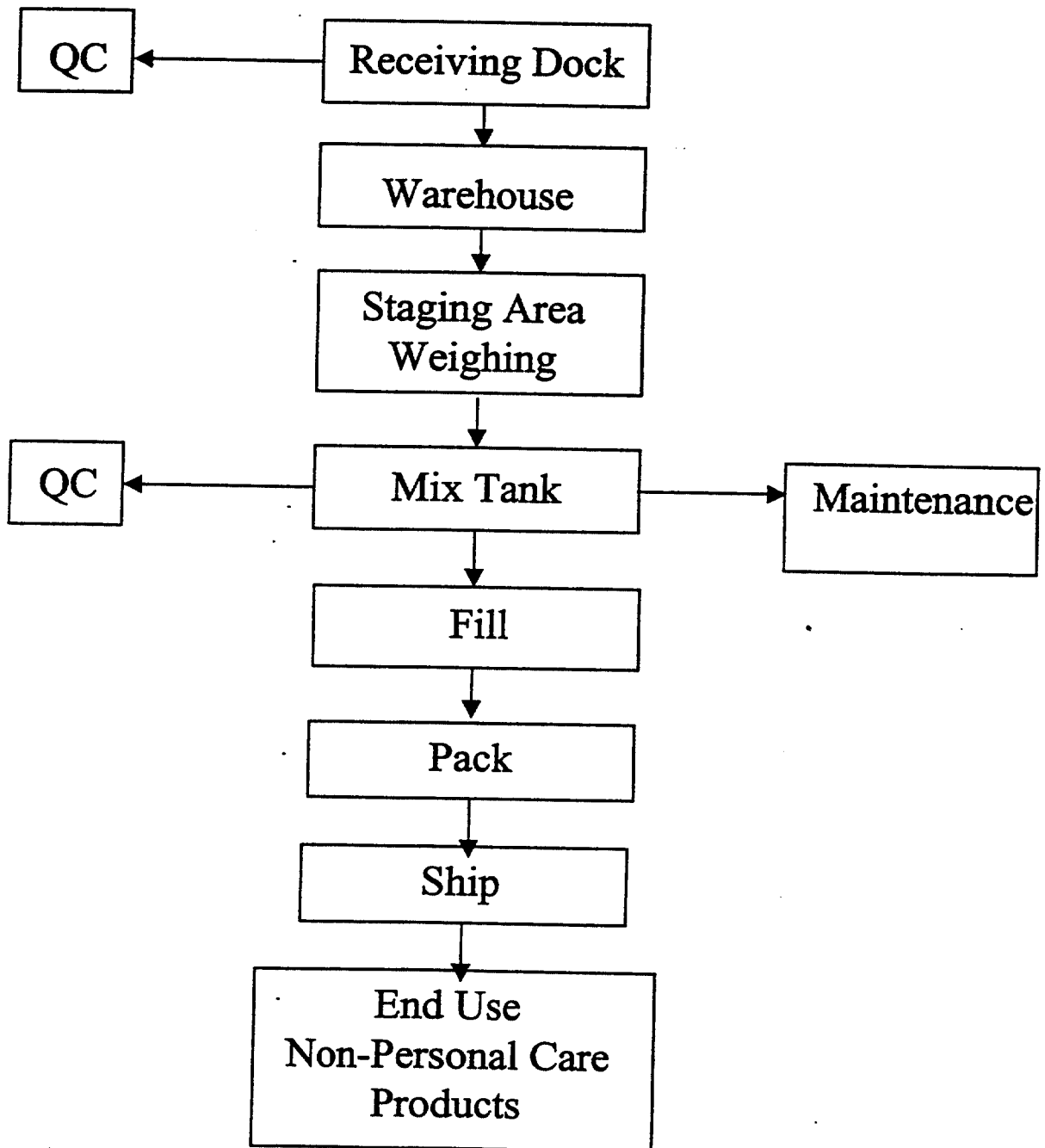
Points of Contact

Powder Additive Formulator

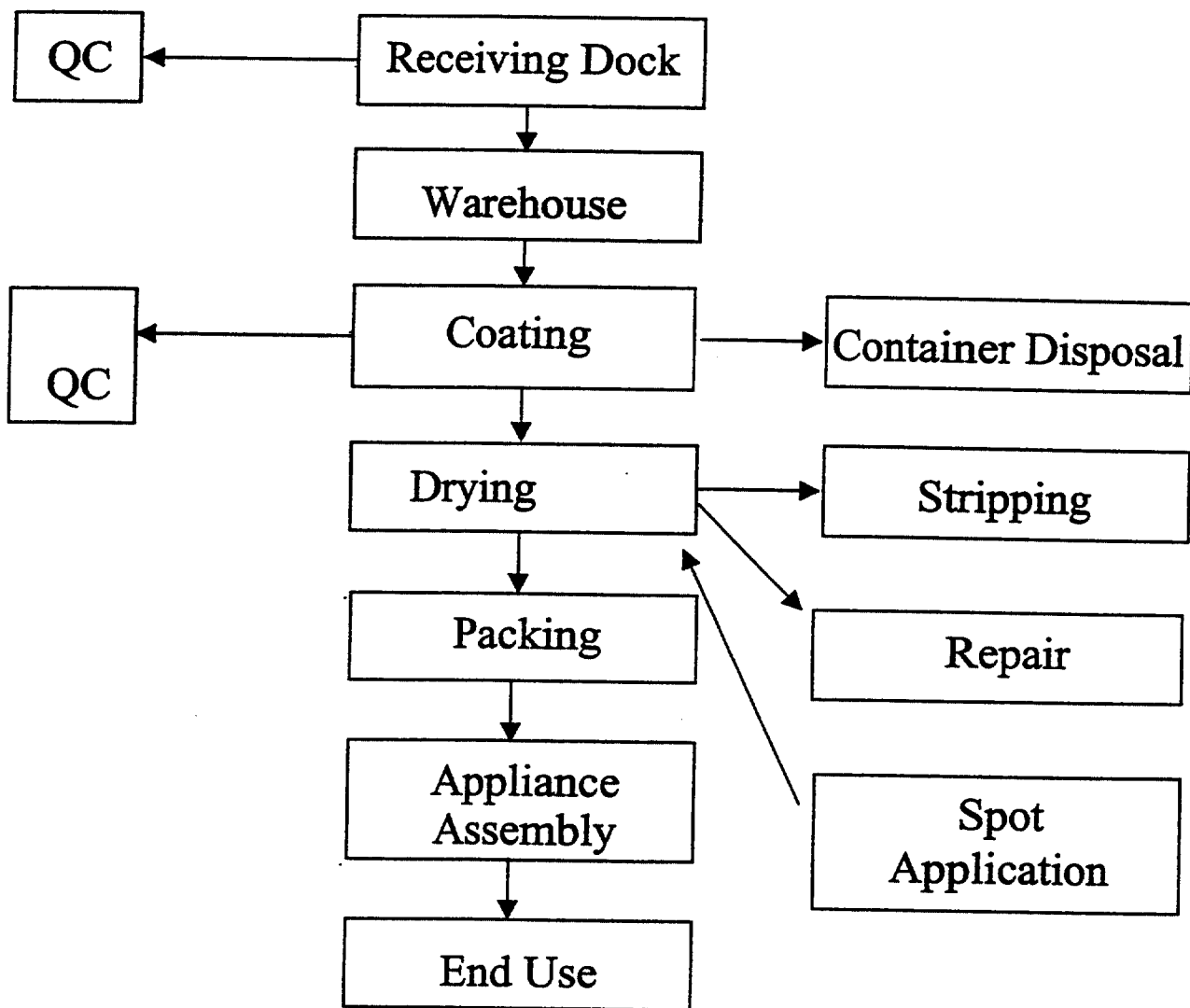


Points of Contact

Powder Additive - 2nd Formulator

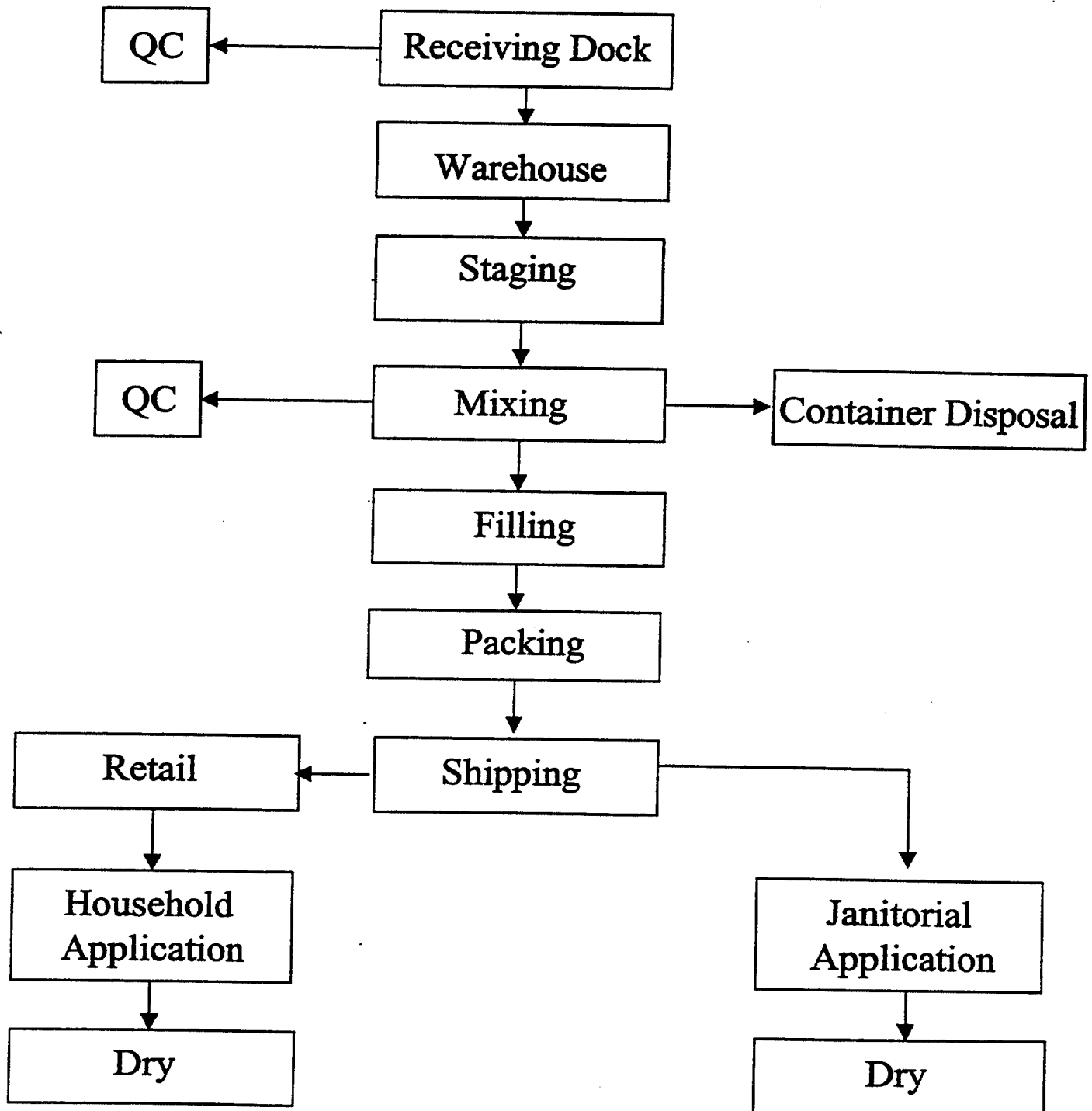


Points of Contact Coating



000360

Points of Contact Coating



3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information - Coating Additives/Inks

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days; Med= 1-4 hrs., 50-100 days; High=>4 hrs, >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
FORMULATOR											X	Low incidence of spills
Receiving		X		1-2	Low	X					X	
QC		X		1-2	Low	X				X		Technically qualified
Warehouse		X		1-2	Low	X					X	Low incidence of spills
Staging		X		?	?	X				X		Low incidence of spills
Pre-dilution		X		?	Medium	X				X		
Container disposal				?	Low	X				X		
Mixing		X		?	Medium?	X				X		
QC				?	Low	X				X		Technically qualified
Filling		X		?	Medium?	X				X		
Packing		X		?	Low	X					X	Low incidence of spills
Shipping		X		?	Low	X					X	Low incidence of spills
FINISHER/END USER												
Receiving		X		1-2	Low	X					X	Low incidence of leakers, spills
QC		X		1-2	Low	X				X		Technically qualified
Warehouse		X		1-2	Low	X					X	Low incidence of spills/leakers
Application		X	X	?	?	X	X	X		X	X	
Curing			X?	?	Low				X?	X?	X?	
Finished product					Low		X					

000303

000303

Exposure Information - Powder Additive

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days, Med.= 1-4 hrs., 50-100 days, High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Formulator												
Receiving Dock		X			Low	X					X	Spills - infrequent
QC		X			Low	X				X		Technically qualified
Warehouse		X			Low	X	X Powder				X	Low incidence of spills/leakers
Staging		X			Low	X				X		Low incidence of spills
Master batching		X	X?		Medium	X					X	
Container disposal		X			Medium	X				X		
Blending		X	X?		Medium		X Powder				X	
QC		X	X		Low		Powder			X		Technically qualified
Filling		X	X?		Medium		Powder			X		
Packing		X	X?		Low		Powder					Low incidence of leakers
Shipping		X			Low		Powder					Low incidence of leakers

000304

Exposure Information - Powder Additive

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days, Med.= 1-4 hrs., 50-100 days, High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
2nd Formulator												
Receiving Dock		X	X		Low		Powder			X		Low incidence of spills
QC		X	X		Low		Powder				X	Technically qualified
Warehouse		X	X		Low		Powder				X	Low incidence of spills
Weighing		X	X?		Medium		Powder			X		
Mix Tank		X			Medium	X					X	
Fill					Medium	X					X	
Pack					Medium	X					X	
Ship												
End Use												
				1-2	Low		Powder				X	Closed Container
Spray		X	X		Medium					X	X	
Electrostatic					Medium							

000305

Exposure Information - Coatings

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days, Med.= 1-4 hrs., 50-100 days, High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving		X		1-2	Low	X					X	Low incidence of spills
QC		X		1-2	Low	X				X		Technically qualified
Warehouse		X		1-2	Low	X					X	Low incidence of spills/leakers
Staging		X		?		X				X		
Mixing		X		?		X				X		
Container Disposal		X		?		X				X		
QC		X		?		X				X		
Filling		X		?		X					X	
Packing		X		?		X					X	
Shipping		X		?		X					X	
Retail		X			Low	X					X	
Household Application		X	X?		Low	X				X		
Household - dry on floor		X			Low		X			X		
Janitorial Application		X	X?		Medium?	X				X		
Dry on surface		X					X			X		

000306

Exposure Information - Coating

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr., <50 days, Med.= 1-4 hrs., 50-100 days, High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving (spills)		X			Low	X						Infrequent
QC		X			Medium	X						
Warehouse (spills)		X			Low	X						Infrequent
Coatings		X			High	X				X		
Drying		X			Low	X	X				X	
Container Disp.		X			Medium	X						
QC		X			Low		X					
Repair		X	X		Low		X		X?			
Spot Application		X			Low	X	X					
Stripping		X			Medium	X	X					
Packing		X			Low		X					
Appliance Assy.		X			Low		X					
End Use					Low		X					

000307

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
CA-1	Formulator of coating additive						X			X					X		
CA-1	End use							X	X	X			X	X	?		

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
CA-2							X			X					X		
CA-2	End Use Wetting Agent							X					X				
CA-2	Formulator of coating additive						X			X					X		
CA-2	End use							X	X?	X			X	X	X		

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000310

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
CA-3	Formulator of coating additives						X			X					X		
CA-3	Varied uses							X		X			X	X			

Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
CA-4							X			X					X		
CA-4								X		X			X	X			

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
CA-5	Formulator of coating additives						X			X			X	X	X		
CA-5	Applier of coating							X		X							
CA-5	Repair						X			X	X						
CA-5	End Use Coating							X		X	X				X		
CA-5	End Use Elect. Coating						X			X					X		

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
CA-6	Tile protector formulator						X			X					X		
CA-6	Tile protector end use					Possible?		X	X	X			X	X	X		
CA-6	Formulator of masonry concrete stucco marble coating						X			X					X		
CA-6	End user applicator							X					X	X	X		
CA-6	End use							X					X	X	X		

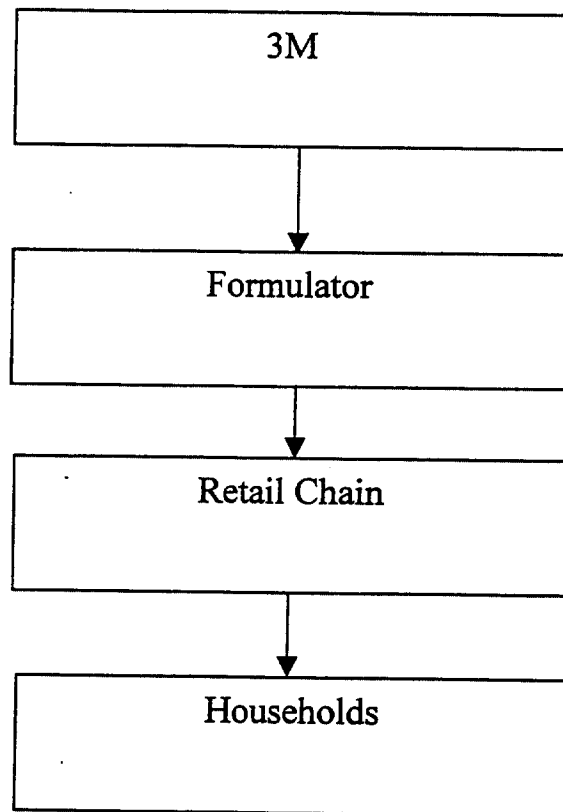
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000314

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

Carpet Spot Cleaner Distribution Chain



000316

Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

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Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

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Product Volumes and Use Patterns																	
Product Code	Process or End Use	Volume Sold	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Water Treatment	Direct Water	
CC-1	Formulator of alkaline cleaner						X			X			X	X	X		
CC-1	Contract fill manufacturer						X						X		X		
CC-1	End Use: Cleaner									X	X	X					

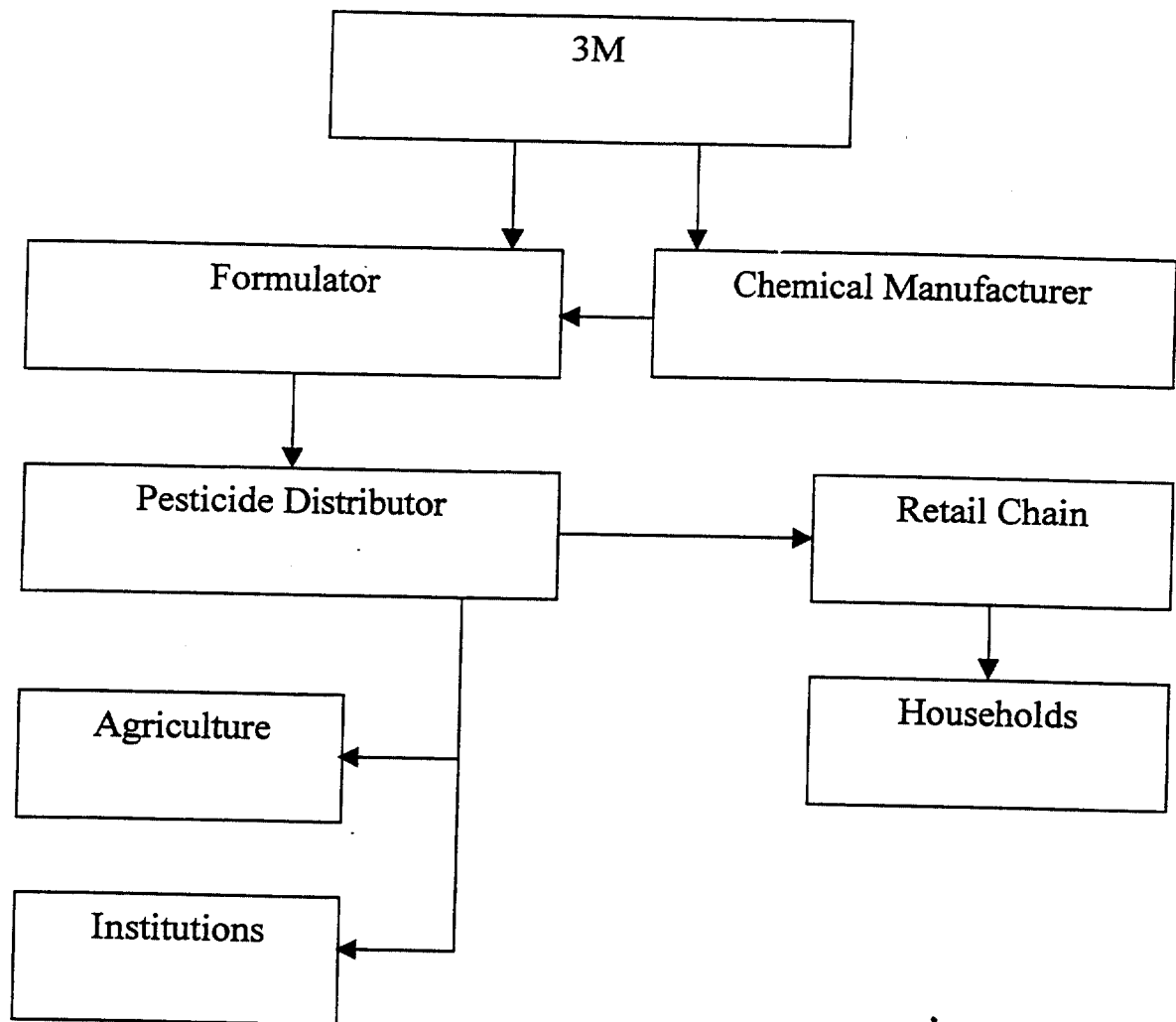
000318

Distribution Chain

This diagram represents the path the 3M product takes from the time it leaves 3M to its ultimate end use. It represents an overview of the significant points where the 3M product may be handled and used. This distribution chain represents the typical use of the product line; not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

000319

Insecticide Distribution Chain



000320

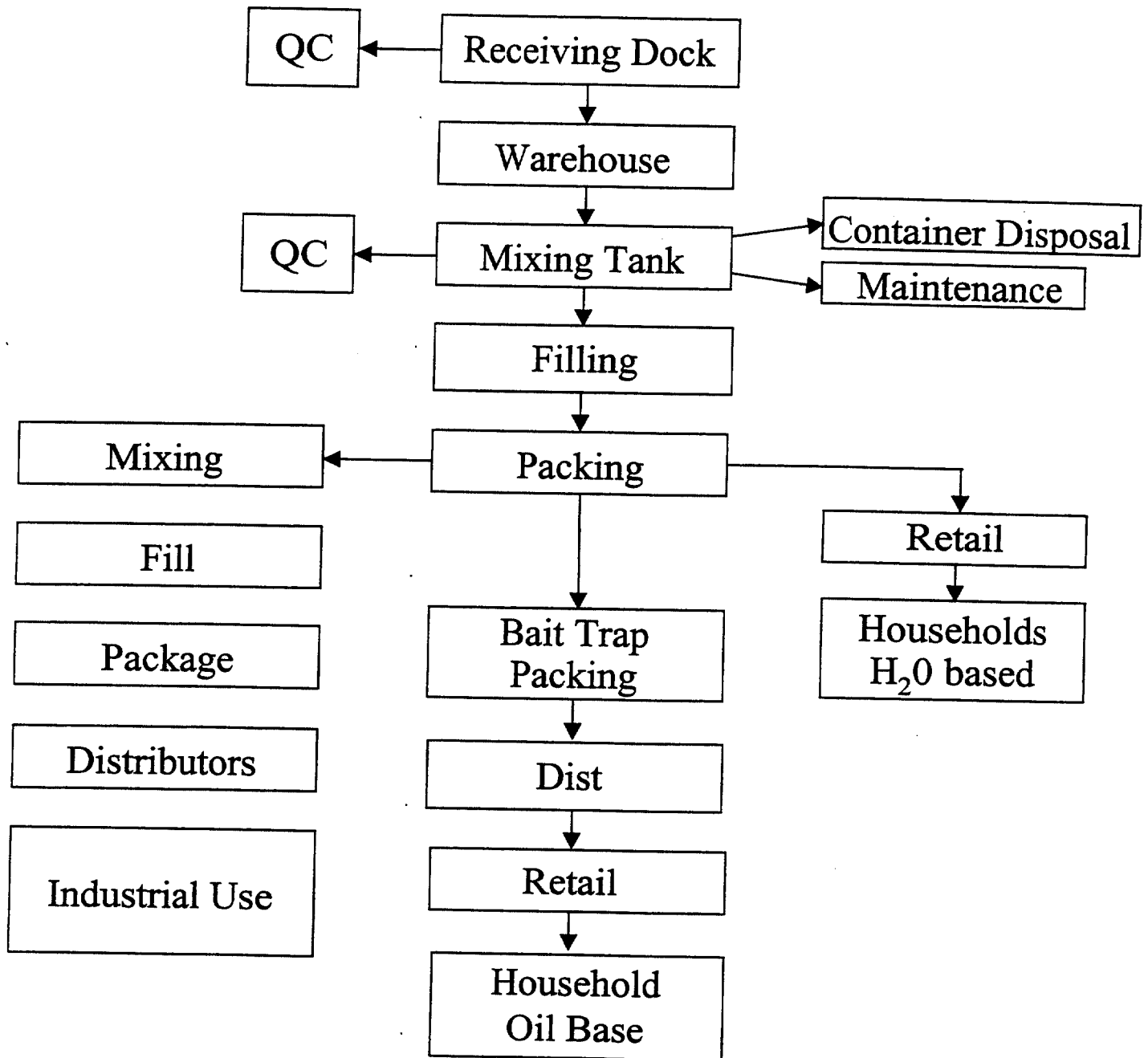
Points of Contact

The Points of Contact diagram details the path the product takes within the distribution chain starting with the arrival of 3M product at the 3M customer. This information was compiled from 3M internal knowledge of the marketplace based on 3M technical service/sales visits and general information from the customer interactions.

000321

Points of Contact

Insecticides



000322

3M Fluorochemical Exposure Information

From the Points of Contact flow chart, each step in the customer use process is isolated. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

Exposure Information - Insecticides

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low= <1 hr, <50 days; Med.= 1-4 hrs., 50-100 days; High= >4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Receiving dock		X		1-2	Low	X	X				X	Low incidence of spills/leakers
QC		X		1-2	Low	X	X			X		Technically qualified
Warehouse		X		1-2	Low	X	X				X	Low incidence of spills
Mixing Tank		X		?	Medium?	X	X				X	
Container Disposal		X		?	Low?	X	X			X		
Maintenance		X		?	Low?	X				X		
QC		X		1-2	Low?	X				X		
Filling				?	Low	X					X	
Packing				?	Low	X					X	
Shipping												
IC-2												
Mixing Tank		X		?	Low?	X					X	
Fill				?	Low?	X					X	
Package				?	Low?		X				X	
Distributors		X		?	Low		X				X	
End Use-Agriculture					Low		X				X	Placed in isolated locations

000324

Exposure Information - Insecticides

Point of Contact	Type of Exposure			Number of Workers (per plant)	Estimated Exposure Times Low=<1 hr, <50 days; Med.=1-4 hrs, 50-100 days; High=>4 hrs., >100 days	Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation			Liquid	Solid	Aerosol	Vapor	Open	Closed	
Retail					Low		X				X	Bait trap closed system
Household - Bait trap					Low		X				X	Bait trap closed system
IC-1												
Retail					Low		X				X	Bait trap closed system
Household - Bait trap					Low		X				X	Bait trap closed system

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Product Volumes and Use Patterns

This summary is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate.

End Use: use of treated substrate.

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M-1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

Amount of Fluorochemical Present: The fluorochemical concentration in process or end use.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sector where the product is used; food, industrial, commercial, and consumer.

Most Likely Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IC-1	Formulator of Insecticide						X			X			hazardous		X		
IC-1	End use-bait trap								X	low	low	low	X	X			

Product Volumes and Use Patterns

Product Code	Process or End Use	Volume FC Solids Sold In 1997	Chemistry	Amount FC Present	% Residuals	Use Pattern				Most Likely Route of Exposure			Environmental Fate				Comments
						Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
IC-2	Formulator of insecticide						X			X			X	X			
IC-2	Insecticide							X									Disposal is direct to land, eaten by leaf cutter ants. Low

Paper and Packaging Business

Fluorochemical Use, Distribution and Release Overview

Foreword

This report is a comprehensive look at exposure to 3M's fluorochemicals in Paper and Packaging business. It attempts to answer the following questions.

- What products are customers exposed to?
- Where does exposure happen?
- What type of exposure is it?

The 3M fluorochemical business is complex and global. Markets served are highly fragmented involving multiple 3M products that are applied to multiple substrates, sold into multiple market segments and used for multiple end products.

Sources

Information for this report was developed solely from internal 3M sources. These include:

- Knowledge of product handling and use practices from field sales and technical personnel.
- Best estimates of end-use applications from known customer activities.
- Internal sales reports.
- Knowledge of worldwide activities (where applicable) by St Paul-based personnel.

How To Read This Report

Situation Analysis:

Provides background on business and products.

Distribution Chain and Points of Contact:

Follows the path of a 3M fluorochemical throughout the distribution chain to final end user. Objective is to identify all points of contact with the fluorochemical – from arrival on customer's loading dock through product usage and disposal.

Exposure Information Charts:

Attempts to quantify type and length of exposure and number of workers exposed to fluorochemicals within the distribution chain.

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Table of Contents

I. Chemical Names

II. Situation Analysis

- A. Business Definition
- B. Product Portfolio
- C. Market Definition
- D. Customer Definition
- E. Fluorochemical application Methods
- F. U.S. Paper Mill Locations
- G. Global Product Volumes (1997)

III. Exposure Information

- A. Supply Chain Flow Chart
- B. Process Flow Chart
- C. Tote/Drum Recovery Cycle Flow Chart
- D. Product Volumes and Use Patterns
- E. 3M Fluorochemical Exposure Information

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Chemical Names

The following is a list of Chemical Abstract Services (CAS) names and numbers for individual products. The following information is presented:

Generic Code: Indicates an internal 3M designation of the product(s).

CAS Number: Indicates the Chemical Abstracts Services number(s) of fluorochemicals contained within each product.

Chemical Name (complete CAS name or IUPAC names if CAS name does not exist): Indicates the Chemical Abstracts Services name(s) of fluorochemicals contained within each product.

Chemical Class: Indicates a shortened, generic chemical name.

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Chemical Names

Generic Code	CAS Number	Chemical Name (complete CAS name or IUPAC name if CAS name does not exist)	Chemical Class
Paper and Packaging			
PP-1, PP-2, PP-3	30381-98-7	1-Octanesulfonamide, N,N'-[phosphinicobis(oxy-2,1-ethanediyl)]bis[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, ammonium salt	Fluorochemical Salt-1
	67969-69-1	1-Octanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-N-[2-(phosphonooxy)ethyl]-, diammonium salt	Fluorochemical Salt-2
	1691-99-2	1-Octanesulfonamide, N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-N-(2-hydroxyethyl)-	Fluorochemical Alcohol-1
	2250-98-8	1-Octanesulfonamide, N,N',N''-[phosphinylidynetris(oxy-2,1-ethanediyl)] tris[N-ethyl-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-	Fluorochemical Alcohol-2
PP-4, PP-5	92265-81-1	Ethanaminium, N,N,N-trimethyl-2-[(2-methyl-1-oxo-2-propenyl)oxy]-, chloride, polymer with 2-ethoxyethyl 2-propenoate, 2-[[[(heptadecafluorooctyl)sulfonyl]methylamino] ethyl 2-propenoate and oxiranylmethyl 2-methyl-2-propenoate	Fluorochemical Acrylate-14
PP-6, PP-7			

Situation Analysis

Paper and Packaging Business

Business Definition

The PCP Paper and Packaging Business Unit provides fluorochemical sizing agents to two broad industry categories: the Packaging Industry and the Paper Industry. The fluorochemical sizing agents impart grease, oil, and water resistance to paper and paperboard substrates, which are used for a number of end use applications that include:

- * Flexible or lightweight papers primarily for bags, wraps and micro flute containers.
- * Board made from recycled fiber used for folding cartons.
- * Solid bleached board for folding cartons.
- * Molded pulp products for plates and food containers.
- * Formulators that blend FC's with other agents, such as varnishes and lacquers, and sell to the converting industry.
- * Business and specialty papers for carbonless forms and masking papers.

Product Portfolio

The product portfolio includes products regulated for direct food contact (under CFR 176.170) and non-food contact products.

Food Contact Products (Regulated for direct food contact)

PP-1

Grease and oil repellent

Ammonium bis(N-ethyl-2-perfluoroalkylsulfonamido ethyl) phosphates

PP-2

Grease, oil and water repellent

Perfluoroalkyl acrylate copolymer of ethanaminium, N,N,N-trimethyl-2-[(2-methyl-1-oxo-2-propenyl)-oxo}-, chloride; 2-propenoic acid, 2 methyl-, oxiranylmethyl ester; 2-propenoic acid, 2-ethoxyethyl ester; and 2-propenoic acid, 2[[[(heptadecafluoro-octyl)sulfonyl] methyl amino] ethyl ester.

Non-Food Contact Product

PP-3

Water and solvent repellent

Perfluoroalkyl acrylate copolymer of 2-propenoic acid, 2 methyl-, polyoxyethylene (3350) diester; and 2-propenoic acid, 2[[[(heptadecafluoro-octyl)sulfonyl] methyl amino] ethyl ester.

Market Definition

The Paper and Packaging business unit defines its markets by the following segments:

- Lightweight papers
- Recycled paperboard (CCN)
- Bleached paperboard (SBS)
- Unbleached paperboard (SUS)
- Formulators (Coatings)
- Business papers (carbonless forms)
- Molded pulp (paper plates)

Fluorochemicals are sold into each of these market segments.

Customer Definition

The Paper and Packaging sales channel includes paper mills, converters, end users, and formulators. The definition of each customer within the channel is:

- A. Paper mills – use fluorochemicals to treat paper fibers during the paper or paperboard manufacturing process.
- B. Converters – convert fluorochemically treated paper and/or paperboard into wraps, bags, cartons, etc., for desired end use.
- C. End users – specify or use fluorochemically treated paper or paperboard for use in their paper or package requirements.
- D. Formulators – blend fluorochemicals with other agents, such as varnishes and lacquers, and market coatings that can be applied to paper and paperboard during the converting process.

Fluorochemical Application Methods

Fluorochemicals can be applied to paper and paperboard substrates during the manufacturing process or converting operation, using different application methods:

Paper Mill

The application points for the fluorochemical at the paper mill can include:

- Wet end of the paper machine
- Size press
- Calender stack
- Clay coating

Converter or Off-Machine Coating Operation

Fluorochemical can be applied using various types of coating or printing equipment.

Approximately 95% of the fluorochemicals used in the paper and packaging industry are applied during the papermaking process at the paper mill. It is estimated that 73% of the fluorochemical used by US paper mills is applied via the size press.

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Global Product Volumes

The table on the following page provides the global volume of 3M fluorochemical sold in the Paper and Packaging business (in 1997) and the estimated breakdown by application process used. Volume information is compiled using 1997 annual shipments and 3M sales and technical personnel best estimates of application methods.

Fluorochemical usage is reported by application method, product family, and geographic region. The product volumes are reported in M (000's) pounds of product solids.

Application Method

SP – size press on the paper machine
CS – calender stack on the paper machine
CC – clay coating applied during paper making process
WE – wet end of the paper machine
FM – formulator
OM – off-machine coating operations

Product Family

The complete chemical description for each of these products is listed in the Situation Analysis under Product Portfolio.

PP-1 Grease and oil repellent – FC aliphatic ammonium salt.
PP-2 Grease, oil and water repellent – FC copolymer.
PP-3 Water and solvent repellent – FC copolymer for business papers.

Geographic Region

United States
Europe
Canada
Latin America
Asia Pacific (APAC)

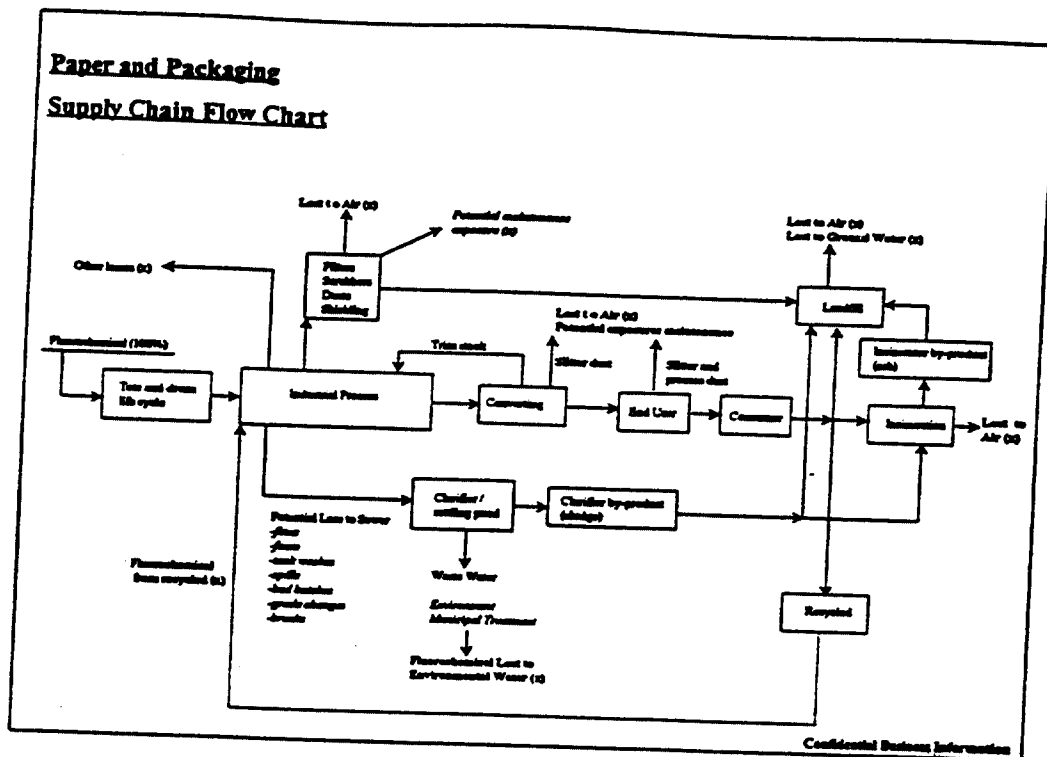
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Exposure Assessment Paper and Packaging Business

The Exposure information in Paper and Packaging follows the path of a 3M fluorochemical throughout the distribution chain from product shipment from a 3M manufacturing location to disposal of the FC treated paper or paperboard. The "Overall Flow Chart" provides a picture of the distribution chain and identifies potential sources of environmental or industrial hygiene exposure.

Potential sources of exposure to the product in concentrated or diluted form is identified in "Tote/Drum Recovery Cycle" and "Supply Chain Flow Chart" diagrams. The "Paper Mill Process Flow Chart" provides additional information in regards to potential chemical exposure to workers in the paper mill.

The information contained in this section was developed solely from internal 3M sources. The knowledge of product handling and use practices from technical and field sales personnel was integral to this development.



The supply chain flow chart illustrates the fluorochemical product delivery to the mill, use in the mill process to make fluorochemical treated paper or paperboard, followed by converting to a useful roll size. Additionally, the mill converted rolls are shipped to a "converter" that produces a useful package construction (eg. multi-wall bags). The converter ships empty packages to the end user for filling or use. The filled bags are shipped to points of distribution (eg. stores) to be sold to consumers.

During this process, the potential for release or contact occurs at the mill (eg. air, water, scrap paper, product contact), at the converter (eg. scrap for recycle), at the end user (eg. scrap), and at the consumer (eg. waste, product contact).

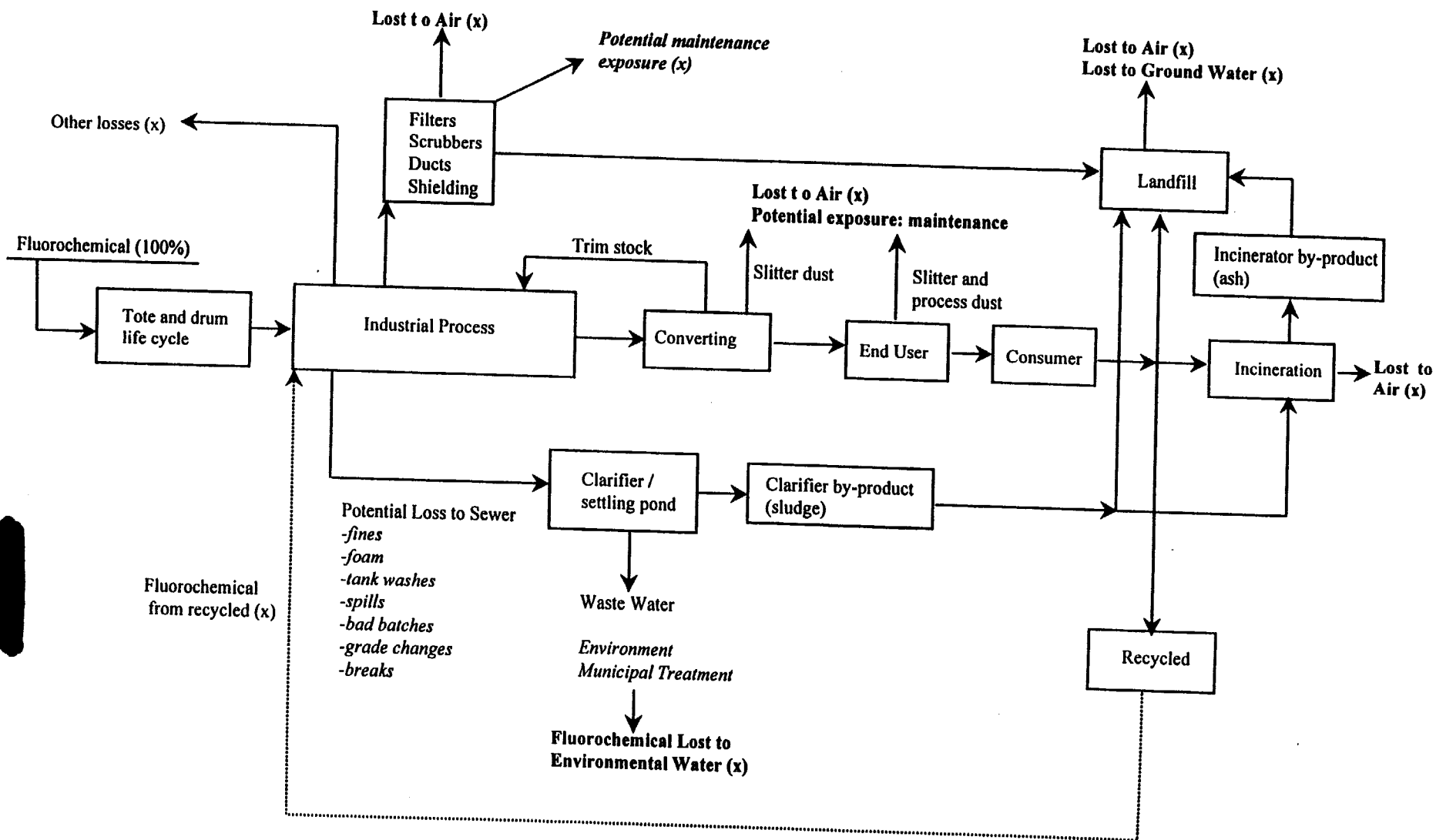
The supply chain represents the typical use of the product, not every product will go through each step. This information is based on 3M internal knowledge of the marketplace.

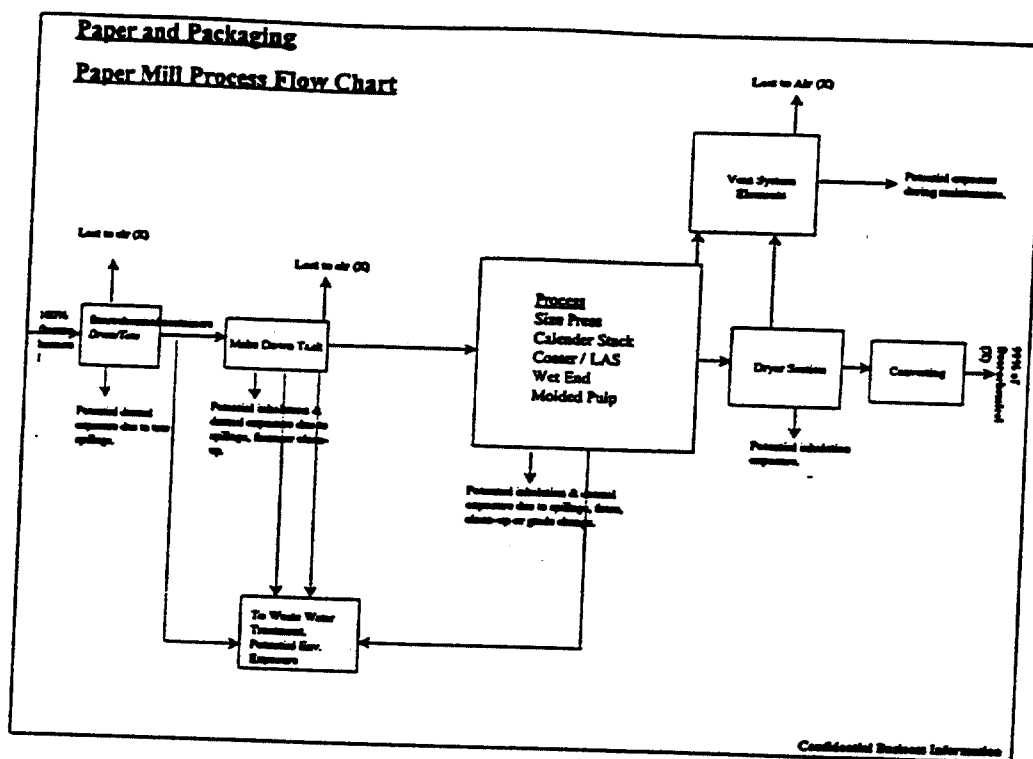
(Full page "Supply Chain Flow Chart" follows on the next page).

Paper and Packaging

Supply Chain Flow Chart

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Totes of fluorochemical product arrive at the paper mill receiving dock and are stored in designated areas. For use in treating paper webs, each tote is moved near the makedown area for pumping to a tank. In some cases, direct pumping of the fluorochemical to a size press operation occur. The fluorochemical is typically applied in a 0.5 to 1% (fluorochemical w/w) concentration in a starch/water solution. After the paper web is treated, the water is evaporated via numerous steam heated dryer cans and collected on a reel. The reel is then transported to a converting line, where the parent reel is slit down to a converting size roll for shipment to the converter.

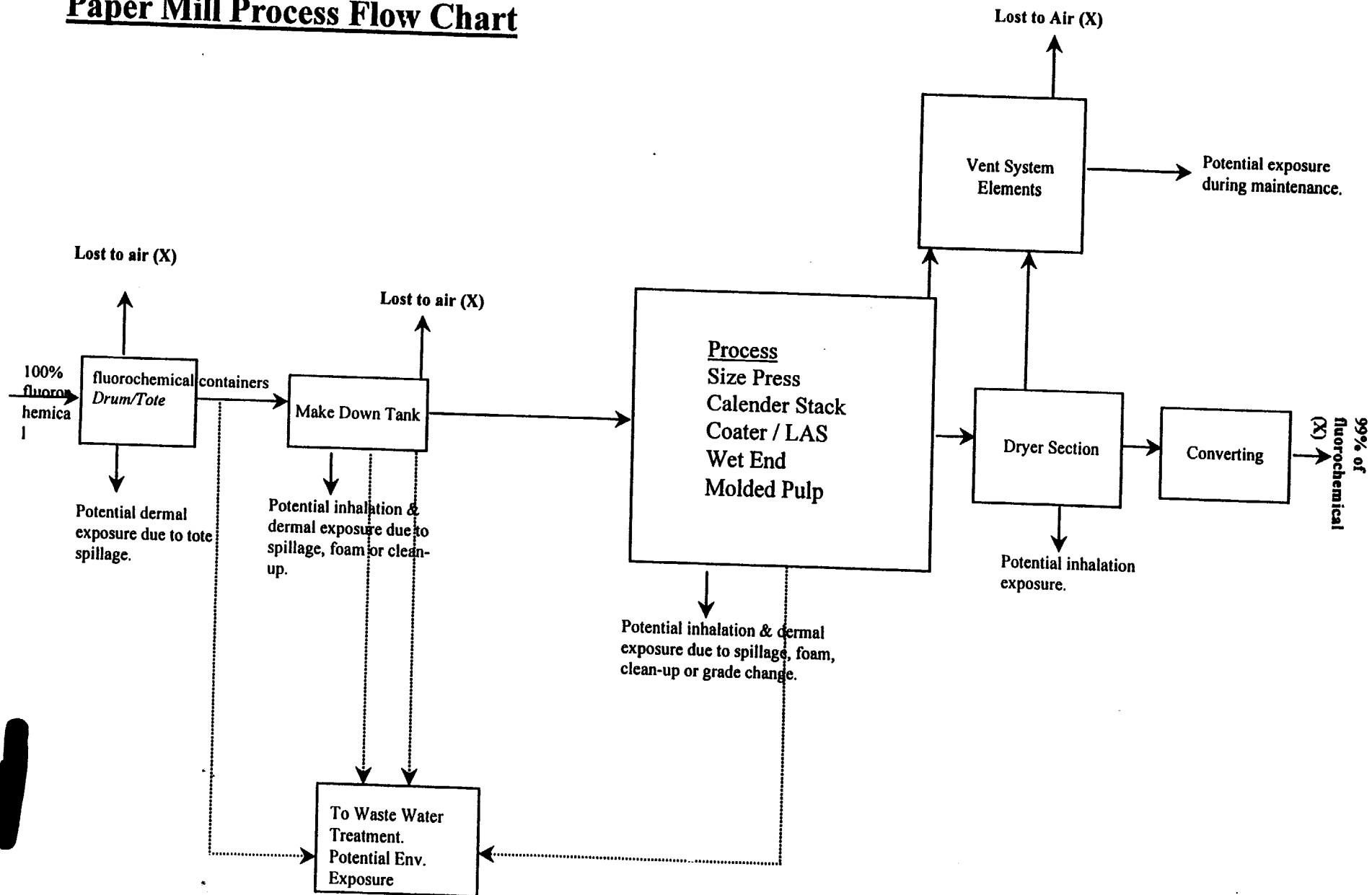
For wet end applications, the fluorochemical product is directly pumped to the pulp slurry prior to forming (either molded pulp or paper machine). Forming is the process of retaining fibers and draining water to form a usable article or web. Following the forming the manufacturing process includes pressing and drying, similar to that described above. Molded articles do not have a converting operation.

This information is based on 3M internal knowledge and best estimates on how customers handle fluorochemical products.

(Full page "Paper Mill Process Flow Chart" follows on the next page).

Paper and Packaging

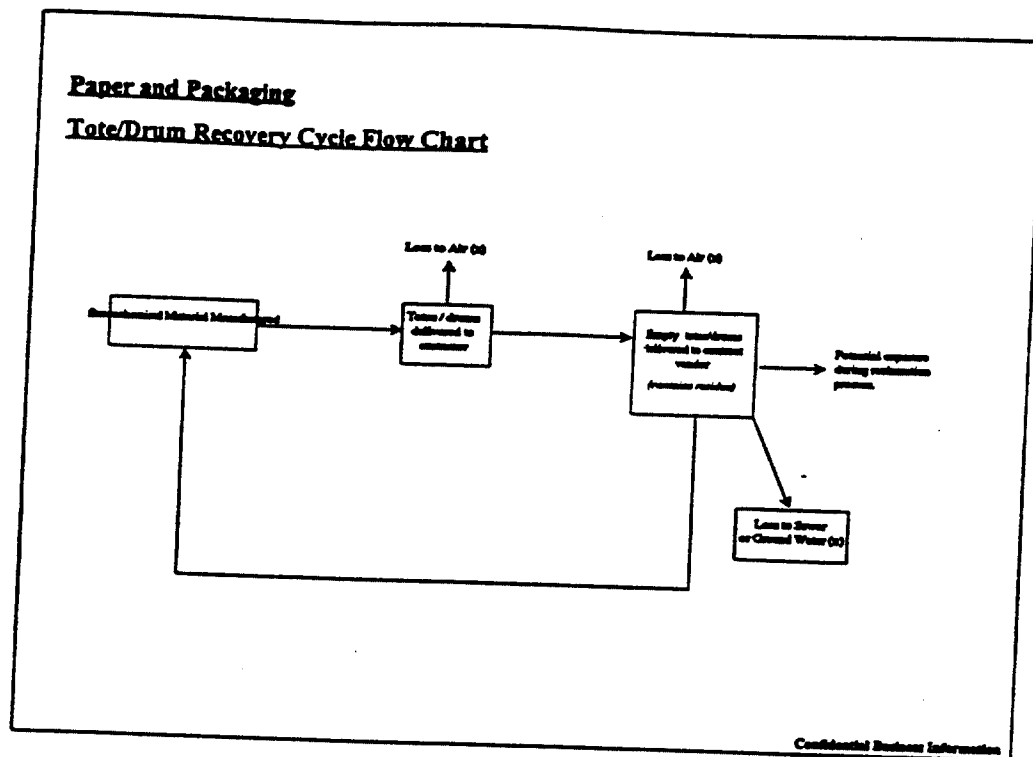
Paper Mill Process Flow Chart



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Paper and Packaging

Tote/Drum Recovery Cycle Flow Chart



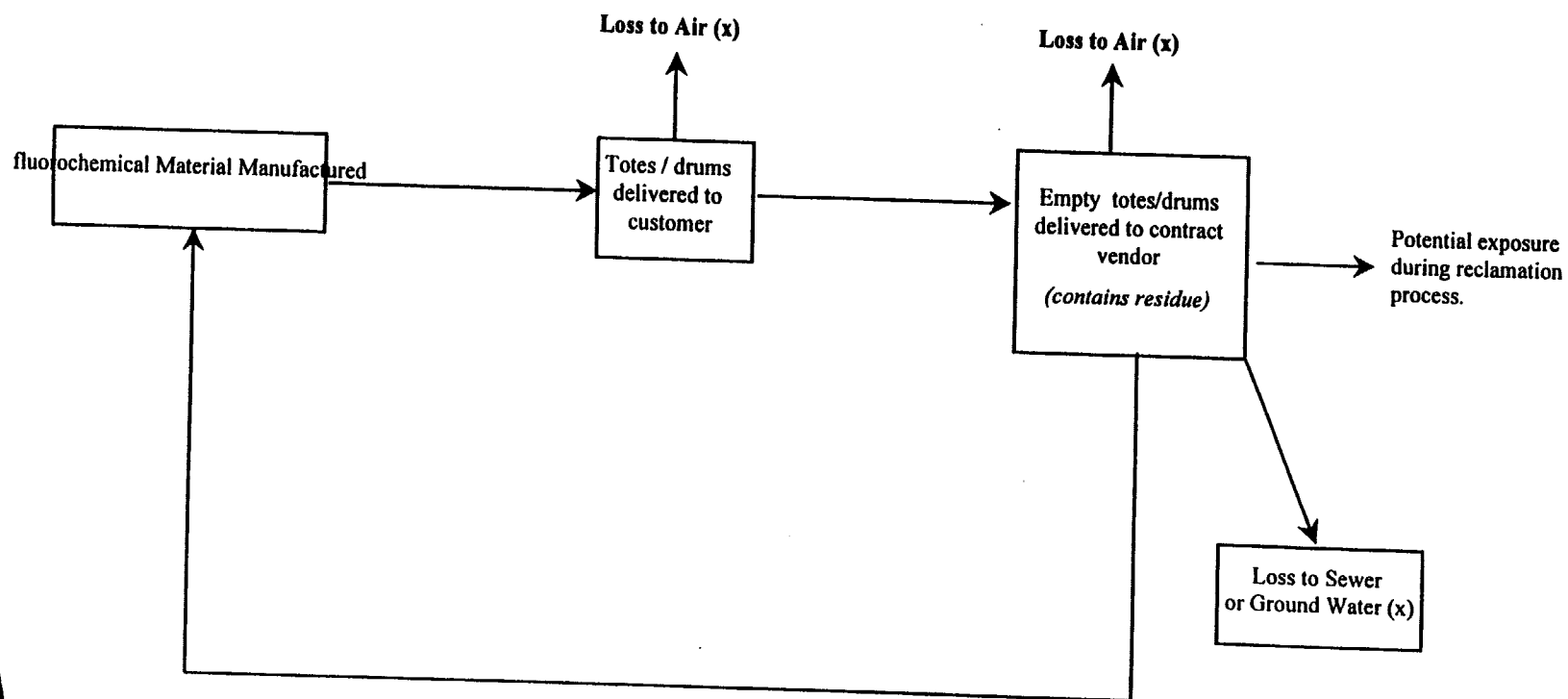
In the tote/drum recovery cycle, totes or drums are distributed to the mill where the fluorochemical product is used in the noted paper mill process. After the product has been consumed in the process, the tote or drum is returned to 3M or sent to a contract vendor for cleaning. The bottom of the empty tote or drum could contain an inch of residue as leftover product. The totes or drums that are cleaned at the contract vendor are returned to the 3M for reuse.

(Full page "Tote/Drum Recovery Cycle Flow Chart" follows on the next page).

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Paper and Packaging

Tote/Drum Recovery Cycle Flow Chart



Product Volumes and Use Patterns

The Product Volume and Use Patterns is based on individual products. It is a description of the application, chemistry, use pattern, exposure and environmental fate.

Product Code: Generic product description.

Application, Process or End Use: The perspective from which exposure was assessed. The route of exposure, the concentration of fluorochemical, the use pattern and the environmental fate may vary with application process or end use – products can be used for more than one application.

Generally the following definitions apply:

Process: use of fluorochemical containing product in another product.

Application: use of fluorochemical containing product to treat a substrate

End Use: use of treated substrate

Volume FC Solids Sold in 1997: Pounds of fluorochemical solids sold in 1997.
(M=1000)

Chemistry: Generic description of fluorochemical ingredients. Full chemical names are listed at the beginning of this section.

% Residuals: Sum total of concentration of the mixture of fluorochemicals that are unreacted or partially reacted starting materials or intermediates.

Use Pattern: Indicates the major sectors where product is used; food, industrial, commercial, and consumer.

Route of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Environmental Fate: Identifies the most likely disposal route for the product; landfill, incineration, waste water treatment, and directly to water.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

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PRODUCT VOLUMES AND USE PATTERNS

Product Code	Process or End Use	Global Volume Sold	Chemistry	% Residuals	Use Pattern				Route of Exposure			Environmental Fate				Comments
					Food	Industrial	Commercial	Consumer	Dermal	Inhalation	Ingestion	Landfill	Incineration	Waste Water Treatment	Direct Water	
PP-1	Size Press					X			X			scrap recycled		from application		
PP-1	Calendar Stack					X			X			scrap recycled		from application		
PP-1	Clay Coating					X			X			scrap recycled		from application		
PP-1	Wet End					X			X			scrap recycled		from application		
PP-1	Formulator					X			X					from application		
PP-1	Off Machine					X			X			scrap recycled		from application		
PP-2	Size Press					X			X			scrap recycled		from application		
PP-2	Calendar Stack					X			X			scrap recycled		from application		
PP-2	Wet End					X			X			scrap recycled		from application		
PP-3	Off Machine					X			X			scrap recycled		from application		
Finished Goods	Paper or Paperboard		PP-1 or PP-2		X		X		X		X	X	X			See FDA risk assessment
Finished Goods	Paper		PP-3				X		X			X	X			

3M Fluorochemical Exposure Information

From the Supply Chain flow chart, each step in the customer use process is isolated in the Point of Contact chart. All information is based on the use and handling of 3M fluorochemicals, materials containing 3M fluorochemicals and articles treated with 3M fluorochemicals. The following information is presented:

Point of Contact: Describes individual steps in the use pattern.

Type of Exposure: Identifies three potential routes of exposure; ingestion, dermal, and inhalation. Marks the most likely route of exposure with an "X".

Estimated Number of Workers: Indicates the number of workers who may have potential for exposure during used.

Estimated Exposure Time: Indicates the amount of time that workers potentially may be exposed during use.

Physical Form: Indicates the physical state (liquid, solid, aerosol, or vapor) of the product at time of exposure.

Open or Closed System:

Open system: is defined as one that allows workers to come in direct contact with 3M fluorochemical.

Closed system: is defined as one that, under normal conditions, does not allow workers to come in direct contact with 3M fluorochemical.

Comments: Provides additional descriptive information.

This information is based on 3M internal knowledge and best estimates on how customers handle 3M fluorochemical products. Information was compiled from available 3M sources including sales, technical service, marketing and regulatory expertise.

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Point of Contact Chart - Mill

Point of Contact	Type of Exposure			Number of Workers (per line)	Exposure Times		Physical Form				Open or Closed System		Comments
	Oral	Dermal	Inhalation		Hrs/Day <1 = Low 1-4 = medium >4 = High	Days/Year <50 = Low 50-100 = medium >100 = High	Liquid	Solid	Aerosol	Vapor	Open	Closed	
Paper Mill													
Loading Dock		X		1	L	L	X					X	Very low, only if spilled, Concentrated product
Mix Preparation													
Direct Metering		X		1	L	H	X				X		Concentrated product
Batch Metering		X		1	M	H	X				X		Concentrated product
Application													
Size Press				3	L	H	X						Dilute product PP-1, PP-2, PP-3
Calender Stack			X	3	L	M	X				X		PP-1
Clay Coating				2	L	M	X			X	X		PP-1, steam vapor
Wet End				2	L	M	X				X		PP-1
Off Machine				3	L	M	X				X		PP-1, PP-2
											X		PP-3
Dryer Section			X	3	L	H	X	X			X		Potential volatilized residuals.
Maintenance		X		2	M	L		X			X		
Converting		X		4	L	H		X			X		
Inspection		X		1	M	H		X			X		