

TABLE OF CONTENTS

INTRODUCTION	1
AUTOMOTIVE REFINISHING INDUSTRY BACKGROUND	2
CHEMISTRY ANALYSIS	6
Definition	6
Hazard Concerns	7
New Chemical Program Review Boundaries	7
Manufacture of Isocyanates (Monomers)	7
Uses of Isocyanates	8
Polyurethane Coating Classifications	8
TOXICOLOGY	13
Repeated Dose Respiratory Tract Toxicity	13
Oncogenicity	13
Respiratory and Dermal Sensitization	14
Dermal Irritation	14
Conclusions	15
OCCUPATIONAL EXPOSURE	15
Worker Activities	15
Number of Workers/Site	16
Inhalation Exposure	16
Dermal Exposure	17
PRODUCTION VOLUMES/DISTRIBUTION	17
PROCESS DESCRIPTION	19
CONTROL TECHNOLOGY	20
Paint Spray Equipment	20
Conventional Air Spray Guns	21
High Volume Low Pressure Spray Guns	21
Low Volume Low Pressure Spray Guns	21
Electrostatic Spray Guns and Powder Coating Systems	22
Spray Booths	22
Crossdraft Spray Booths	23
Downdraft Spray Booths	24
Semi-Downdraft Spray Booths	24
RESPIRATORY PROTECTION	24

OPPORTUNITY FOR RISK REDUCTION AND INNOVATION	25
Engineering Opportunities	25
Green Chemistry Opportunities	26
Practices in Isocyanates Manufacture	27
Huls A.-G.'s Urea Adduct-based, Phosgene-free Diisocyanate Process	27
Daicel's Phosgene-free Process to Produce Diisocyanates via Diurethanes	27
Union Carbide Corp. - CO ₂ - based Process to Produce Diisocyanates	28
Akzo Corp., Obernburg (Germany) - Phosgene-free Process to Produce Diisocyanate	28
Practice in Other Area	29
Environmental Benefits of the Technology	30
VOC Reduction in Polyurethane Paints	30
Waste Reduction	30
Control of Release into Aqueous Environments	30
 ENVIRONMENTAL RELEASES	 30
 ENVIRONMENTAL FATE	 31
Volatilization	31
Sorption	31
Hydrolysis	32
Biodegradation	32
 REGULATORY HISTORY	 32
 REFERENCES	 36
 APPENDIX A - ISOCYANATE CHEMICAL CATEGORY	 40
APPENDIX A-1 - DEFINITIONS	42
APPENDIX A-2 - CLARIFICATION OF MONOMER CONTENT IN PREPOLYMERS AND POLYMERS	45
APPENDIX B - SPRAY PAINT EXPOSURE SUMMARIES FOR ISOCYANATES	46
APPENDIX C - PAINT AND ALLIED PRODUCTS: QUANTITY (000 GALLONS) AND VALUE (\$000) FOR SELECTED SIC CODES, 1990-1994	48
APPENDIX D - 1992 ECONOMIC CENSUS DATA FOR SELECTED AUTOMOTIVE AND PAINT-RELATED SIC CODES	50
APPENDIX E - COMPARISON OF CHARACTERISTICS OF PAINT SPRAY EQUIPMENT FOR AUTOMOTIVE REFINISHERS	51
APPENDIX F - COMPARISON OF CHARACTERISTICS OF PAINT SPRAY BOOTHS ..	52
APPENDIX G - SUMMARY OF REGULATORY ACTIVITY FOR EACH OF THE ISOCYANATE CAS NUMBERS	53

LIST OF EXHIBITS AND FIGURES

Exhibit 1.	Notable Characteristics of the Primary Polyurethane ASTM Designations	10
Exhibit 2.	Commercially Important Diisocyanates	11
Figure 1.	Automotive Refinishing Trade Channels of Distribution	18