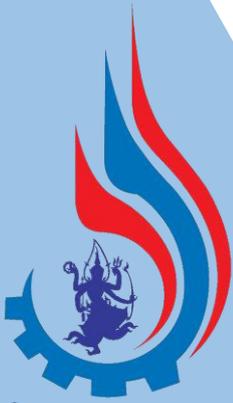


Public Disclosure Authorized



กรมโรงงานอุตสาหกรรม
DEPARTMENT OF INDUSTRIAL WORKS

Public Disclosure Authorized

Public Disclosure Authorized

Public Disclosure Authorized

ENVIRONMENTAL MANAGEMENT FRAMEWORK



THAILAND HCFC PHASE-OUT PROJECT STAGE 2

SPRAY FOAM SECTOR

ENVIRONMENTAL MANAGEMENT FRAMEWORK

THAILAND HCFC PHASE-OUT PROJECT STAGE 2

SPRAY FOAM SECTOR

Made by Department of Industrial Works, Ministry of Industry

Consultants Assist. Prof. Dr. Amarin Kongtawelert

Department of Occupational Health and Safety

Faculty of Public Health

Mahidol University

Year 2019

Page 103

Edition 1

CONTENTS

	Page
List of Abbreviations	ii
1. Introduction	1
2. Objectives of the environmental management framework	2
3. Project description	3
4. National Laws and Regulations	7
5. World Bank Safeguards Policies	15
6. Environmental impact and other effects	17
7. Mitigation measures and Environmental Management Plan (EMP)	19
8. Conditions and procedures for preparing an environmental management plan (EMP)	21
9. Monitoring and Reporting	22
10. Roles and responsibilities for implementation of Environmental Management Framework	23
11. Training and capacity building for EMF Implementation	25
12. Technical assistance for participating spray foam enterprises	26
13. Grievance Redress Mechanisms (GRM)	27
14. Budget for EMF/EMP implementation	28
15. Stakeholders Consultations	29
ANNEX	
ANNEX A Schematic diagram of a spray foam unit and Chemical formula	31
ANNEX B Safety Data Sheet	32
ANNEX C Personal Protective Equipment for spraying foam	83
ANNEX D Chemical management	84
ANNEX E Environmental Management Plan (EMP)	85
- Attachment 01	88
- Attachment 02	89
- Attachment 03	92
- Attachment 04	94
- Attachment 05	95
- Attachment 06	96
- Attachment 07	97
- Attachment 08	98
ANNEX F Minutes of meeting, listening and commenting	99
References	103

List of Abbreviations

CAS No.	Chemical Abstracts Service Number
CFC	Chlorofluorocarbon
CO ₂	Carbon dioxide
DIW	Department of Industrial Works
EMF	Environmental Management Framework
EMP	Environmental Management Plan
GHG	Greenhouse Gas
GHS	Global Harmonized System
GSB	Government Savings Bank
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
HFO	Hydrofluoroolefin
HPMP	HCFC Phase-out Management Plan
MLF	Multilateral Fund
SDS	Safety Data Sheet
MT	Metric Ton
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substances
PU	Polyurethane

1. Introduction

Thailand ratified both the Vienna Convention on Protection of the Ozone Layer and the Montreal Protocol (MP) on Substances that Deplete the Ozone Layer on July 7, 1989. As an Article 5 signatory of the MP, Thailand has fulfilled its obligations to phase out consumption of all controlled substances except for HCFCs. The Department of Industrial Works has revised the guidelines of import HCFCs into the country in accordance with the Montreal Protocol's obligations and conditions for receiving multilateral funds under the Montreal Protocol. All According to the Notification of Department of Industrial Works on Guideline of the HCFC import for domestic usage, B.E. 2559 (Issue 2)).

The implementation of the Stage I HCFC Phase-out Project had completed in December 2018. The proposed Thailand HCFC Stage II project is a continuation of Thailand HCFC Phase-out Stage I Project targeting reductions of HCFC-141b in the spray foam sector. The project will provide technical and financial assistance to eligible manufacturers, primarily in the spray foam sector, to reformulate new foam systems (polyol and blowing agent) and retooling manufacturers with new equipment compatible with new foam systems. The proposed project will support adoption of low-GWP blowing agents consistent with the Kigali Amendment of the MP. The proposed alternatives for conversion from HCFC 141b in spray foam sector are HFOs and CO₂ and it is likely that two HFOs (HCFO-1233zd and HFO-1336mzz-Z) will be selected as alternatives for the conversions. In addition, the project will support a limited number of eligible commercial refrigeration manufacturers to demonstrate low-GWP alternative technologies for commercial refrigeration equipment.

The project will be implemented with the World Bank as Implementing Agency and in accordance with the World Bank Policies and Guidelines and the guidelines of the Montreal Protocol. As per the Bank Guidelines, Environmental Management Plans (EMP) will have to be prepared for each participating Spray foam enterprise before they sign Sub-grant agreements for their HCFC-141b phase-out. Since foam companies to be funded cannot be identified prior to the project appraisal, Mahidol University has been engaged by the DIW to assist in preparation of this Environmental Management Framework (EMF) which aims to provide guidance for each participating foam enterprise on preparation of EMP. The EMP will be prepared by each spray foam enterprise and attached with sub-grant proposal during the HCFC-Stage II implementation phase before signing of sub-grant agreement. Each of the spray foam enterprise will also comply with relevant requirements stipulated in Thailand laws and regulations including on occupational health and safety, environment and social.

2. Objectives of the Environmental Management Framework (EMF)

This EMF has been prepared in consistent with the World Bank's Operational Policy (OP)/Bank Procedure (BP) 4.01 - Environmental Assessment (EA) and in accordance with Thai National Laws and Regulations. To the extent relevant the applicable World Bank Group Environmental Health and Safety Guidelines has been considered when preparing the EMF. The main objectives of the EMF are to:

- (1) Identify potential risk associated with the conversion to alternative spray foam system;
- (2) Provide information on safety and environmental requirements and capacities needed for the introduction of alternative spray foam system;
- (3) Describe procedures and methodologies for proper storage and handling of alternative spray foam blowing agent, in particular protective equipment and safety measures for the conversion to alternatives spray foam system in compliance with applicable national regulations and international standards.
- (4) Provide guidance for the preparation of an Environmental Management Plan (EMP) for participating spray foam enterprises;

3. Project description

3.1 Thailand HCFC Phase-Out Stage II Project

The project development objective is to contribute to reducing HCFC consumption in Thailand. The project consists of four proposed components as described below.

Component 1: Investment in HCFC Consumption Reductions

The project will finance conversion in the spray foam sub-sector and for demonstrating alternative low-GWP non-ODS technology in the commercial refrigeration sector. This includes:

- (a) Provision of sub-grants to beneficiary enterprises in the spray foam sub-sector to carry out HCFC consumption reduction subprojects;
- (b) Demonstration sub-project for the conversion of high GWP HFCs used as refrigerants for manufacturing commercial refrigeration equipment.

Financial support will be provided to spray foam enterprises consuming HCFC-141b in their production processes (i.e., as a blowing agent). This covers about 71 enterprises and system houses. The project will finance conversion to low-GWP HFO alternatives i.e. HFOs and CO₂ and it is likely that two HFOs (HCFO-1233zd and HFO-1336mzz-Z) will be selected as alternatives for the conversions. The following cost will be supported by the project: (i) handling and storage for HFOs and new foam systems; (ii) trial production and training of spray foam enterprises; and (iii) incremental operating cost of the alternative technologies for a transitional period. For system houses, the project will finance: (i) development and testing of new foam formulation based on HFOs; (ii) cold room for storage of HFOs; and (iii) premixing unit for HFOs and polyols.

In addition, the project will finance a demonstration sub-project for the conversion of high GWP HFCs used as refrigerants for a commercial refrigeration manufacturer (Patana Intercool).

Component 2: Technical Assistance

This component is designed to strengthen capacities of relevant government agencies, technical institutes and private entities that engage in HCFC import/export, handling, use, and end-of-use including policy and standard development to facilitate market transformation in the spray foam sector.

Component 3: Project Management

This component will provide technical assistance support to the project management units (PMUs) of DIW and GSB, which will continue to provide project management support on a day-to-day basis (building on experiences from Stage I).

Component 4: Strengthening of the National Ozone Unit (NOU)

This component will provide technical assistance to strengthen the capacity of the NOU to fulfill the obligations of the Recipient under the Montreal Protocol.

3.2 Current blowing agents application

Polyurethane Foam is a product from polymerization reaction between isocyanate and polyol. Thermal insulation of the polyurethane foam can be obtained from tiny cavities in its structure. The small cavities resulted from the tiny gas generated impromptu with the polyurethane polymer. The gas can be carbon dioxide derived from the reaction between isocyanate and water (water-blown technology), and the addition of volatile organic compounds in the polymerization reaction (called blowing agents). The heat from exothermic reaction turns volatile liquid to gas within polyurethane foam.

For foam spraying, the two reactants containing in two separate 200-L drums are mixed altogether. The first drum is isocyanate (MDI) and the latter is a mixture of polyol, water and a blowing agent. The currently used blowing agent is HCFC-141b will be replaced with a mixture of water and HFO-1233zd or a mixture of water and HFO-1336mzz-Z. The two chemical drums are pre-heated and delivered with a pump. They are mixed at the spraying gun to form polyurethane foam. The schematic diagram of polyurethane foam spraying unit is shown in Annex A.

3.3 Background of PU Spray Foam Sector in Thailand

Montreal protocol gains the most accomplishment in conservation of the world environment. The protocol set the goal to decrease and eliminate the use of ozone depleting substances. Hydrochlorofluorocarbons (HCFCs) have been temporarily substituted for Chlorofluorocarbons (CFCs), which were widely used and banned on January 1, 2010 under the Montreal protocol. HCFCs still have an impact on depleting the ozone layer but their ozone depletion potentials are less than those of CFCs. Moreover, HCFCs are also Greenhouse Gas (GHG) which have Global Warming Potentials (GWP) in a range of 100 to 1,000 compared to carbon dioxide whose GWP is 1. The alternative substances in spray foam sector such as HFOs have zero ozone depletion potential (ODP) and low GWP.

Table 3-1 Ozone depletion potentials and Global Warming Potentials for several blowing agents

Chemical name	Flash point (°C)	ODP	GWP
CFC-11	No data	1	4750
HCFC-141b	No data	0.11	725
HFC-134a	No data	0	1300
HFC-245fa	No data	0	1050
HFC-365mfc	- 24	0	840
n-Pentane	- 49	0	11
Iso-Pentane	- 51	0	11
Cyclopentane	- 37	0	11
CO ₂	No data	0	1
HFO 1233zd	Not flammable	0	1
HFO 1336mzz-Z	Not flammable	0	2

According to department of industrial works, HCFC Phase-Out Management Plan (HPMP) Stage I has been addressed in PU foam sector since 2016 except for spray foam sector.

Based on the results from the survey conducted for Thailand HCFC Stage II project, the spray foam sub-sector consists of 102 enterprises which currently 71 enterprises are eligible for Thailand HCFC Stage II support. These spray foam enterprises can be divided into three groups according to their annual HCFC 141b consumption rate:

Group 1: More than 10 MT/Year (5 enterprises);

Group 2: Between 2-10 MT/Year (8 enterprises);

Group 3: Less than 2 MT/Year (58 enterprises)

3.4 Field visit

3.4.1 Storage area

The study team had surveyed at the chemical storage areas of the selected enterprises, interviewed the owners for the purchasing, storage procedure before using the chemicals in the fields. The enterprises visited comprised of 1 of Group 1 enterprise, 2 of Group 2 enterprises, and 1 of Group 3 enterprise.

3.4.2 Working areas of spray foam

The study team had surveyed the spraying foam areas and interviewed the owners for the standard procedures; chemical transportation, installation of the spraying equipment, spraying gun, spraying process, personal protective equipment (PPE), cleaning of the equipment after used, chemical exposure from foam spraying. The survey included visits to Group 1 enterprise (1 enterprise) and Group 2 enterprise (1 enterprise).

According to the survey, we found that the work procedures of Group 1 and Group 2 enterprises are similar except for the use of personal protective equipment. Group 1 (large enterprise) has paid more attention to health and safety of the workers than Group 2 (medium enterprise) due to the fact that the workers from large enterprises have been trained for safety before they get to work in factories. It is a basic requirement for the outsourcing before they are allowed to work. In terms of chemical storage, the enterprises usually order the chemicals in quantity required for each work from suppliers. They do not store chemicals in a large quantity.

3.5 Chemical substitute

3.5.1 A mixture between hydrofluoroolefins (HFOs) and water (H₂O)

Hydrofluoroolefins or HFO are a group of unsaturated hydrofluorocarbon potentially used as blowing agents. The compounds in this class, which will be substituted for HCFC-141b, include HFO-1233zd and HFO-1336mzz-Z. They both have considerably low GWP and zero ozone depletion potential (ODP). The main reason of lower values results from their shorter life cycle of the molecules in the atmosphere. They also have low toxicity and better energy efficiency. This type of blowing agents is pre-blended a tank with polyol by a supplier.

For HFO-1233zd, it has quite low boiling point (19°C) compared to Thailand ambient temperature. It is supplied in a compressed gas cylinder. A cylinder should be kept in well

ventilated area that is protected from sunlight and should not expose to temperature exceeding 55 °C. Read guidelines for storage, handling or SDS before use the chemicals. Before off-loading the product, it is suggested to store the container indoor overnight, if possible.

Carbon dioxide is a product from the reaction between isocyanate and water. This gas is simultaneously generated with the polymerization reaction and provides the cavity in polyurethane foam. In particular, CO₂ is environmentally friendly and offers a long-term sustainable solution, due to its zero Ozone Depletion Potential (ODP) and its lowest Global Warming Potential (GWP), set equal to 1 as reference to other greenhouse gases. Also, carbon dioxide is non-flammable and non-toxic.

The additional information of substitutes are listed in Annex B.

3.6 Cleaning solution for spraying equipment and apparatus

Methylene chloride

Methylene chloride is an organic solvent that is recently used to clean spraying equipment and all apparatus. Methylene chloride is clear liquid, nonpolar, water immiscible. The density is 1.32 g/mL with the boiling point 39.6°C, which make methylene chloride easily evaporates at the ambient temperature.

In terms of toxicity, methylene chloride causes skin and eye irritant. Moreover, it is probably carcinogenic to humans. Therefore, the worker must handle methylene chloride with care. The chemical should not get exposed to skin or inhalation.

The additional information of methylene chloride and PPE are listed in Annex B and C.

4. National Laws and Regulations

To prevent and control the impact, if any, from implementation of the HCFC Phase-Out Stage II, the participating spray foam enterprises shall comply with national laws and regulations related to health and safety and environment listed below. These laws are enforced by Ministries of Industry, Labour Welfare and Protection, Public Health, and Interior Affairs.

Table 4.1 Relevant National Laws and Regulations

Laws and Regulations	Brief Description of Laws / Regulations
Ministry of industry	
Factory Act B.E. 2535 (1992) and Factory Act (2 nd Issue) B.E. 2562 (2019)	<p>Factory Act (2nd Issue), B.E. 2562 (2019) was announced in the Government Gazette on April 30th of 2019 and shall become enforceable in the next 180 days upon the publication. The definition of “Factory” means a building, place, or vehicle with a machine of 50 or more horse powers or an equivalent power, or has 50 or more workers with or without any machine for factory engagement according to category or type of factory as prescribed in a ministerial rule.</p> <p>Factory Act, B.E. 2535 (1992) categorized factory into 3 groups which are Group 1, Group 2 and Group 3 as according to the Annex in the Ministerial Regulation (Issue 1) which described each group as followed:</p> <p>(1) Group 1 factory is factory of the type, kind, and size that can be established and engaged immediately upon the desire of a person for factory engagement.</p> <p>(2) Group 2 factory is factory of the type, kind, and size that a person must notify the authority for factory engagement and abide by the Ministerial Regulation (Issue 2).</p> <p>(3) Group 3 factory is factory of the type, kind, and size that a person must be granted a factory establishing permit prior to the factory engagement and abide by the Ministerial Regulation (Issue 5).</p> <p>Factory Act (2nd Issue), B.E. 2562 (2019) prescribed Group 1 and 2 factories located in local government organization area will be controlled by their own local government organization and regulated by Ministry of Industry.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
<p>Hazardous Substance Act B.E. 2535</p>	<p>HFO-1336-mzz-Z is listed as Category 3 Hazardous Substance: the production, importation, exportation, or possession of which requires licensing obtained from Ministry of Industry and must comply to all the regulations, also, responsible to the damage or loss caused by this hazardous substance.</p> <p>The producer of hazardous substance shall have the duty of care in procuring substance to be sued as production material, laying down trustworthy production method and procedure, providing safe, strong, and secure container for use, moving and transportation, providing labels that clearly and sufficiently display the harmful nature of such substance, providing storage propriety and examining the propriety of the recipient or the person who could be expected to be the recipient of such hazardous substance from him or her.</p>
<p>Industry Ministerial Regulation on Prescribing the Standard for Factory Electrical Safety System B.E. 2550 (2007)</p>	<p>The employer of Group 2 and 3 factories must have the electrical system installation as-built drawing and lists of inventories with the drawing. This drawing must be prepared by certified professional electrical engineer. All components of the electrical system must comply with international or universal standard. Annual inspection of the electrical system is required and must prepared by certified professional electrical engineer. An inspection report and related documents must be kept at the workplace in case the ministerial inspector requested.</p>
<p>Industry Ministerial Notification on Fire Prevention and Protection B.E. 2552 (2009)</p>	<p>Factory building must have full coverage of fire detector and fire alarm equipment as appropriate to each area and emergency exit. Particularly the non-occupied area where electrical equipment is installed or used or storage area of flammable or combustible materials, automatic fire detection and fire alarm systems must be installed. Fire alarm equipment must be of self-trigger type independent from the power system for lighting or machinery, or equipped with electrical backup system for at least 2 hours.</p> <p>Factory building must Install the portable fire extinguishers throughout the area and perform the regular check-up, schedule maintenance according to the procedure. Must install the grounding or bonding to any equipment, devices, storage tanks, reactors which use the flammable material.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
	<p>Must set up the fire prevention, protection and evacuation planning according to Fire Prevention and Protection for Factory Handbook B.E. 2552 (2009)</p>
<p>Industry Ministerial Notification on Safety Standard of Working Environmental Conditions in Workplace B.E. 2546 (2003)</p>	<p>An employer must perform the annual inspection, analysis, and working conditions related to heat, lighting, and noise level at least once a year. Methods for inspection and analysis must perform according to the universal standard. The report must be prepared by certified person and keep at workplace in case of requesting by ministerial officers.</p> <p>For occupational heat exposure level in workplace, it must not exceed the allowable average WBGT based on level of working intensity. There are 3 level of working intensity which are light, medium, and heavy level. If the temperature of working environment exceed the allowable limit, the employer must notify the employee and try to resolve this issue immediately. If the problem still exists, personal protective equipment for protecting heat exposure must be provided to employees and training must be provided.</p> <p>For recommended lighting level at work, every workplace must have suitable and sufficient lighting based on the workplace area and characteristics of tasks. Preventing glare or flicker from lighting must be performed for equipment usage.</p> <p>For noise level control in workplace, the levels of exposure to noise of your employees average over a working day or week should not exceed the recommended level based on number of working hours. If the noise level exceeds the limit, the employer must notify the employee and try to resolve this issue immediately.</p>
<p>Industry Ministerial Notification on Hazardous Substances Inventory (3rd Issue) B.E. 2559 (2016)</p>	<p>HFO-1336-mzz-Z was added into 5.1th inventory list under the responsibility of the Department of Industrial Works.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
Industry Ministerial Notification on Storage of Hazardous Substances under the Responsibility of the Department of Industrial Works B.E. 2551 (2008)	Hazardous substance operators shall carry out safety measures in accordance with the notification of the Department of Industrial Works regarding the storage manual, chemicals, and hazardous substances B.E. 2550 (2007)
Industry Ministerial Notification on Transportation of Hazardous Substances under the Responsibility of the Department of Industrial Works B.E. 2558 (2015)	Duties of safety transportation of hazardous substances for the producer, importer, exporter, person having in possession of the hazardous substances, transporter, and recipient of hazardous substances were shown in this Government notification.
Industry Ministerial Notification on Disposal of Waste and Unwanted Materials B.E. 2548 (2005)	<p>The allowable time limit for storing waste or unwanted materials is not more than 90 days. If the factory required to store more than 90 days, it must obtain a permit (SK.1) from the Department of Industrial Works.</p> <p>The factory must have emergency response incident plan such chemical leakage, fire or explosion of its own waste or unwanted materials as shown in Annex 3 in this Government notification.</p> <p>In order to transport waste or unwanted materials out of the area, it required the permission from the director-general of Department of Industrial Works.</p> <p>In case of hazardous waste, the factory must use the authorized personnel or company which registered with the Department of Industrial Works for collecting, transporting, or treating/disposing of their hazardous waste. The manifest of waste must be keep at the generator (factory), transporter, and send to Department of Industrial Works.</p> <p>Annual report (SK3) must be submitted to Department of Industrial Works within March 1st, of the following year.</p>
Industry Ministerial Notification on Storage of Chemicals and Hazardous Substances Handbook B.E. 2550 (2007)	This Government Notification is about the storage of chemicals and hazardous substances handbook which published in B.E. 2550 (2007) by Department of Industrial Works, Ministry of Industry.

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
Ministry of Labour	
Occupational Safety, Health, and Working Environment Act B.E. 2554 (2011)	<p>An employer shall provide an occupational safety, health and environment training to be attended by an Executive, a Supervisor and an employee in order to safely administer, manage and operate the occupational safety, health and environment.</p> <p>Whereas an employer employs an employee to work, changes work, changes workplace or changes machinery or equipment that may be harmful to life, physique, mentality and health of an employee, an employer shall provide a training for every employee before commencing work. The training shall be in conformity with criteria, methods or terms as stipulated by the Director-General.</p>
Labour Protection Act B.E. 2541 (1998)	<p>An employer shall treat male and female employee equally in employment unless description or nature of work prevents such treatment.</p> <p>An employer shall concern with human right, fairness, safety and health of the employee: male, female, pregnant, and young workers (under 18 years of age), working hour, vacation days, wages, overtime pay, severance pay, legal right, welfare and employee welfare fund.</p>
Labour Ministerial Regulation Prescribing the Standard for Administration and Management of Occupational Safety, Health and Working Environment on Fire Prevention and Protection B.E. 2555 (2012)	<p>An employer shall provide the fire prevention and protection system and maintain this system to the efficiently and safely operation condition. Procedures for extinguishing fire and emergency evacuation shall post in workplace.</p> <p>A workplace with more than 10 employees shall conduct the fire prevention and protection plan and provide at least 2 emergency route to exit from the building with appropriate lighting combined with backup power unit on each floor.</p> <p>An evacuation route shall be able to lead employee safely exit the building within 5 minutes.</p> <p>A workplace with more than 2 storeys or has more than 300 square meter shall install fire detector in every floor and have portable fire extinguisher based on type of fire. Each floor shall provide a map with the portable fire extinguisher location.</p> <p>Any obstruction objects shall not place in the area where a fire portable extinguisher locates.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
	<p>An inspection of fire portable extinguisher shall perform at least once in every 6 months with validate date of inspection date.</p> <p>A fire drill shall conduct at least once a year with at least 40 percent of the employee who work in workplace</p>
<p>Labour Ministerial Regulation Prescribing the Standard for Administration and Management of Occupational Safety, Health and Working Environment on Electricity B.E. 2558 (2015)</p>	<p>An employer shall provide working procedure regarding the operation of safety, occupational health, and working environment regarding electricity for employees to follow.</p> <p>An employer shall provide training for employees performing electrical work to have knowledge, understanding and skills necessary to work safely according to the assigned duties.</p> <p>An employer shall provide and maintain the electrical circuit diagram installed in the establishment.</p> <p>An employer shall inform employee to the hazard of electricity by electrical safety poster.</p> <p>An employer shall perform the maintenance all electrical system in safely condition.</p> <p>An employer shall install appropriate numbers of electrical outlets, equipment, and surge protectors though out the workplace with universal standard certified by Engineering Institute of Thailand.</p>
<p>Labour Ministerial Regulation Prescribing the Standard for Administration and Management of Occupational Safety, Health and Working Environment on Confined Space B.E. 2562 (2019)</p>	<p>An employer shall make a signboard with the text inscribing “Confined space, Danger, Do not Enter” The signboard shall be in conspicuous size and installed openly at the entrance and exit of every confined space.</p> <p>An employer shall not permit employee or any person to enter the confined space unless the employer has provided the safety measure in according to this Ministerial Regulation; and such employee or such person has been permitted by the person who is responsible for granting permission and who is trained.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
	<p>An employer shall provide the health checkup to employee who work with risk within 30 days from the first day of employee is employed and the subsequent health checkup shall be conducted at least once a year.</p> <p>A health checkup shall be conduct to the employee when there are new risk factors take place or when changing to the difference of tasks/jobs.</p> <p>A detail of health checkup shall record in employee health report.</p> <p>An employer shall inform the result of health checkup to the employee. In case the health checkup result is normal, such employee shall be informed within seven days from the date of acknowledgement of the result. If there is an abnormal result, an employer shall inform employee within 3 days and required the medical treatment to that person. An employer shall investigate the abnormality of the result in order to prevent this type of incident to repeat in the future and required to submit the result of the investigation to the labour inspector within the 30 days from the abnormality has been found. Any employees who could not perform the same duty which result by the abnormality, an employer shall proceed to change such job.</p>
<p>Department of Labour Protection and Welfare Notification on Portable Fire Distinguisher Standard B.E. 2556 (2013)</p>	<p>Portable fire extinguisher standards shall comply with National Fire Protection Association (NFPA), American National Standards Institute (ANSI), Australia Standard (AS), British Standard (BS), or International Standardization and Organization (ISO)</p>
<p>Department of Labour Protection and Welfare Notification on Personal Protective Equipment Standard B.E. 2554 (2011)</p>	<p>Personal protective equipment shall comply with International Standardization and Organization (ISO), European Standards (EN) Australia Standards/New Zealand Standards (AS/NZS) American National Standards Institute (ANSI), Japanese Industrial Standards (JIS), The National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA) or suitable to their nature of works.</p>

Table 4.1 Relevant National Laws and Regulations (cont.)

Laws and Regulations	Brief Description of Laws / Regulations
The Ministry of Interior	
Building Control Act B.E. 2522 (1979)	Buildings under control of use under this Act are any building occupied as warehouse, hotel, commercial, medical center, industrial, education institute, public health or others shall acquire a permit or notify to the local officer when there are construction, modification, or transportation in order to protect the safety in life, properties and health of people who occupied in these types of buildings and protect the environmental pollution.

5. World Bank Safeguards Policies

The World Bank applies 10 Safeguards Policies, which set the mandatory requirements for Borrowers relating to the identification and assessment of environmental and social impacts. Thailand HCFC Phase-Out Stage II project triggers one safeguards policy namely Environmental Assessment OP/BP 4.01. This EMF has been prepared to assess and address potential impacts from conversion of spray foam from HCFC 141b to low-GWP alternatives using HFOs and/ CO₂ according to OP/BP 4.01 requirements. To the extent relevant the World Bank Group EHS (Environment Health and Safety) Guidelines have been considered in the preparation of the EMF. The relevant content of World Bank OP 4.01 and EHS is described in Table 6.1 below:

Table 5.1 World Bank Safeguards

World Bank Safeguards	Abstract/Descriptions
Environmental Assessment (EA) (OP 4.01) ⁴	<p>Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental impacts associated with Bank operations. EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project’s potential environmental risks and impacts and identifies ways of preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts.</p> <p>This project triggers OP 4.01 because its supports for conversion from HCFC-141b to Low-GWP technology in Spray Foam sub-sector and for one demonstration project to convert commercial refrigeration to R-32 technology or HFC/HFO blended technology may generate low to moderate risks to the environment and occupational health and safety. The anticipated impacts will be site-specific and can be mitigated by proper mitigation measures. Therefore, the project is classified as Category B EA according to the World Bank OP/BP 4.01. This EMF has been prepared to assess and address potential impacts from conversion of spray foam from HCFC 141b to low-GWP alternatives using HFOs and/ CO₂ according to OP/BP 4.01 requirements.</p>

<p>World Bank Group Environmental, Health & Safety (EHS) Guidelines⁵</p>	<p>The Environmental Health and Safety Guidelines (EHS) are technical reference documents with general and industry-specific examples of Good Industry Practice (GIP), as defined in IFC's Performance Standard on Pollution Prevention and Abatement. The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and generally considered to be achievable in new facilities at reasonable costs by existing technology. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.</p>
---	---

6. Environmental impact and other effects

Thailand HCFC Phase-Out Stage II project aims to contribute to reducing HCFC consumption in Thailand by replace HCFCs with low-GWP alternatives. The project will provide technical and financial assistance to eligible manufacturers, primarily in the spray foam sector, to reformulate new foam systems (polyol and blowing agent) and retooling manufacturers with new equipment compatible with new foam systems which the proposed alternatives are HFOs (HFO-1233zd and HFO-1336mzz-Z) and CO₂. While conversion from HCFCs provide benefits to the global environment as HCFCs are ozone depleting substances and high global warming gases, conversion to alternatives substances could lead to other adverse impacts which should be assessed and mitigated properly. The following section describe positive and negative environmental and social impacts from the proposed conversions. Additional details on chemicals properties, effect and guidance for proper handling are available in Chemical Safety Data Sheet (SDS) (Annex B).

1) Ozone Depletion: Phasing-out of HCFC 141b by the project will contribute positively to the recovery of the ozone layer due to its will support conversion from HCFC 141b which is an ozone depleting substance to HFOs (HFO-1233zd and HFO-1336mzz-Z) and/ CO₂ alternative which are non-ODS.

2) Global Climate Change: HCFC 141b is greenhouse gas with global warming potentials (GWP) of 725. The project will have a positive impact on the global climate change as alternative blowing agents are low-GWP substances with approximately 362- 725 times lower GWP than that of HCFC 141b.

3) Local Air Pollution: HCFC, HFOs and CO₂ are chemically stable and do not affect local air quality. While the environmental impact of this emission is expected to be minor, emissions from the foam blowing process will be contained through regular leak inspections.

4) Soil and water contamination: other chemicals used in spray foam industry are Methylene Diphenyl Diisocyanate (MDI), amine catalyst and fire retardants. The probability that a spill of polymeric MDI (liquid at room temperature) contaminates the soil and water is very low, because the floor of the foam storage areas and foam spraying areas are typically cement coated with an anti-leakage, low permeability chemical layer such as epoxy. If MDI leaks into the soil, it will react with moisture or water, and the reaction would result in CO₂ and insoluble polyurea compounds, which are non-biodegradable and chemically inert. Fire retardant and amine catalysts (very small amount) are mixed with polyol by system house suppliers. They remain in the final foam products and are not emitted to the environment during foam spraying or later.

5) Fire hazards: HFOs and CO₂ are not flammable, so there is no impact on fire hazard from the use of foam spraying.

6) Occupational health and safety: The project will support participating spray foam enterprises to convert from HCFC 141b to lower GWP (HFOs /CO₂) technology. The

conversion will involve replacement of foam blowing agent, HCFC 141b, with the new alternatives (HFO-1233zd and HFO-1336mzz-Z). Other chemicals used for the foam production comprising of polyol and isocyanate are still the same (with some adjustment in formulation).

Both HFO-1233zd and HFO-1336mzz-Z are nonflammable substances. HFO-1233zd is considered practically nontoxic by the inhalation route of the exposure. Workplace exposures with HFO-1336mzz-Z would likely occur via the inhalation route. The 4-hour LC50 in rats of >102,900 ppm (v/v) indicates that the substance has low acute inhalation toxicity. However, Personal Protective Equipment (PPE) should be worn to prevent possible exposure to the chemicals used for the foam spraying works. Other OHS risks associated with foam spraying may be derived from different working conditions at foam application sites for example working at height, working in areas with poor ventilation, working in attics and crawlspaces, working in high temperature or outdoor areas, etc. These risks can be prevented/minimized through implementation of good practices and use of PPE as described in Chapter 7.

In addition – and unrelated to the conversion technology supported by the project – participating enterprises must implement and observe certain OHS measures related to the use of Isocyanate (MDI), which is one of the chemicals used in foam production and which is a moderate health and environmental hazard.

7) **Waste management:** solid wastes generated from foam spraying works include scrap spray PU foam, liquid spray PU foam component chemicals and empty drums. These solid wastes are expected to be minimal and should be disposed of in compliance with laws and regulations on waste disposal and in accordance with guideline in the manufacturer's SDS.

8) **Social impact:** The project support to participating enterprises will be carried out within the existing locations of project beneficiaries or in spray foam application sites. There will be no land acquisition or involuntary resettlement and job lost related impact from the project activities. Similar to the outcome of the project in Phase I, the outcome of the phaseout in this project is gender neutral. The project will provide equal opportunity for male and female workers to participate in training and other capacity building activities.

In addition to above discussion, all of the potential participating spray foam enterprises are Small-Medium enterprises, number are limited (around 71 enterprises) and most of them are in Group 3 which has HCFC 141b consumption less than 2 MT/Year and can be considered as small/micro-scale investment. Considering that the project will finance conversion of HCFC 141b blowing agent to Non-ODS and low-GWP chemicals that are non-flammable and has low toxicity and that potential participating enterprises are only 71 small-medium enterprises, it could be concluded that the anticipated adverse impacts on the environment and social from the project are low to moderate and could be managed through implementation of good mitigation measures.

7. Mitigation measures and Environmental Management Plan (EMP)

7.1 The necessity of an environmental management plan

Participating spray foam enterprises shall prepare Environmental Management Plan (EMP) following forms provided in Annex E, which covers mitigation measures described in the following section. The enterprises are required to follow mandatory requirements in regulations related to environmental, social and OHS management applicable to their operations.

1. Hazard Awareness

The enterprises should ensure that their employee receive adequate trainings to build awareness, knowledge and skill for a safe working condition. The trainings topics may include safe work practices, equipment inspection and maintenance, storage of hazardous materials in accordance with the announcement of the Department of Industrial Works on the Manual for Storage of Hazardous Substances 2007, working at height, proper working posture, working outdoors/ in hot weather, use and maintenance of personal protective equipment, etc. Inspection check list should also be provided and implement before work commencement.

2. Personal protective equipment

PPEs shall be provided and strictly enforced. For staff working in the foam spraying area PPEs may include protective cloth, respiratory protection systems/masks, chemical goggles, and chemical protection gloves, particularly when deal with spilled chemicals, safety harness (in case working at height), etc. (Annex C)

3. Waste management

Storage and disposal of wastes including scrap spray PU foam, liquid spray PU foam component chemicals and empty drums must comply with the requirements specified in the Manual for the Storage of Hazardous Substances, 2007 announced by the Department of Industrial Works, guideline in the manufacturer's SDS and follow engineering best practices as practical.

4. Installation of electrical systems and equipment

Comply with the standards in Thailand in determining the standard of electrical equipment installation in industrial plants, such as the Industrial Ministerial Regulation prescribing safety standards regarding electrical systems in factories, 2007 and other relevant regulations. Inspect to ensure that electrical equipment and wiring are in safe and good conditions before carrying out foam spraying works.

5. Ventilation

In the case that it is necessary to carry out works in poor ventilated areas e.g. ???, efforts should be made to improve ventilation and air circulation of working areas. For example, install suction fan, provide temporary air opening, where possible.

6. Fire prevention and suppression

In the chemical storage area should comply with the laws and regulations on fire prevention and suppression systems, such as the installation of movable fire extinguishers, etc. and follow the manual for the storage of hazardous chemicals.

7. Standards of operation and training regulations

Participating enterprises should establish work procedures and ensure that employee who involve in receiving, storage, lifting, moving, and spraying foam has adequate training to perform works safely.

8. Inspection and maintenance

Safety inspections and assessments before and after the use of machines and equipment in the foam injection process should be carried out as specified in Annex E. In addition, spray foam enterprises can also seek advice from equipment supplier.

9. Working at Height

In case foam spraying works involve working at height activities, sufficient plan, training and measures should be provided. This include provision of secure scaffolding/guard rails, sufficient and proper PPEs (e.g. safety harness) and training on how to use PPEs, only allow people with sufficient skills and experience to perform the task, etc.

10. Working in confined spaces (if relevant)/ Attics

Working in confined spaces such as the space under the roof, under the floor of a building that is tall enough to crawl (Crawlspaces), and silos. Employers must have a safety plan and measures for employees who work in such conditions including install ventilation equipment, provide mask/breathing apparatus, and oxygen measuring instruments, and other necessary PPEs to prevent injury or incident at work place. The enterprises must follow regulatory requirements concerning working in confined spaces that are applicable to their works.

11. Working in hot weather

In case of spraying foam in hot areas such as on the roof or under the roof especially in the summer, employers must provide protection from hot air hazards, such as proper work clothes, providing adequate clean drinking water, and periodic breaks.

12. Transporting chemicals to the work site

Vehicles that transport chemicals from the company to the work site must consider requirements on safety of chemical transportation where relevant, such as vehicles must be able to prevent the leakage of chemicals into the environment and there are signs or markings showing the loading of hazardous materials attached to the vehicle clearly.

13. Chemical storage

Proper storage is needed for all chemicals. Dry and cool area is needed for isocyanate because isocyanate can react with moisture or water to product carbon dioxide resulting in high pressure in a drum. All the SDS are available and accessible. (Annex D)

8. Conditions and procedures for preparing an environmental management plan (EMP)

For the spray foam company that wants to participate in this project will be a company listed in the spray foam company list of the Department of Industrial Works by the steps in preparing the environmental management plan (EMP) of each company Can study from the EMP preparation guidelines in the Annex E

Participating enterprises must prepare an environmental management plan (EMP) following procedures and forms provided in Annex E, which the enterprises can seek advice from the DIW-Project Management Unit (PMU) in preparing the EMP. The enterprises shall submit EMP together with technical proposal to the Government Savings Bank (GSB) and copy to PMU in order to request for financial support to convert to new foam system. The PMU will evaluate the enterprise eligibility for project support based on their established date and compliance with the multilateral fund (MLF) criteria. Once eligibility is confirmed, GSB and PMU will review the subproject proposals and supporting documents, verify HCFC consumption, appraise and confirm the technical and financial feasibility of the proposals and recommend the appropriate level of funding.

9. Monitoring and Reporting

The DIW-PMU will take overall responsibility to ensure that the EMF requirements are effectively implemented including carrying out supervision and monitoring of EMP implementation by participating enterprises. Each participating enterprise will be required to submit EMP monitoring form to the PMU and GSB within 6 months from sub-grant agreement signing using forms in Annex E. The PMU will randomly conduct site visits to monitor the safeguard implementation compliance periodically, prepare biannually project safeguards progress report that provide an overview of project safeguards implementation status and performance and share with the World Bank in each Project Implementation Support Mission (ISM). The World Bank task team will supervise the implementation of the project including its environmental and safety provisions during the project ISM. Supervision will include discussion with selected spray foam enterprises and site visits.

10. Roles and responsibilities for implementation of Environmental Management Framework

10.1 Spray Foam enterprises

10.1.1 Before conversion:

- Prepare an EMP for the implementation of the conversion project.
- Ensure that valid operating or business license is in place.
- Request from chemical supplier the safety data sheets for each chemical used in the foam production process.

10.1.2 After start of production:

- Implement measures as specified in the EMP.
- Submit EMP monitoring form to the PMU and GSB within 6 months from sub-grant agreement signing using forms in Annex E
- Report accidents to the competent authorities and PMU.
- Report production and consumption data to the Project Management Unit (PMU) as required (foam produced, and HFOs consumed).

10.2 The Project Management Unit (PMU)

The PMU of Department of Industrial Works is responsible for the proper management and oversight of the overall HCFC phase-out project including environmental and safety aspects of each HCFC conversion sub-project. In execution of this responsibility, under guidance from Department of Industrial Works and the World Bank, the PMU will:

- Set up eligible criteria for screening of participating enterprises.
- Evaluate the enterprise eligibility for project support based on their established date and compliance with the multilateral fund (MLF) criteria.
- Provide technical assistance or support to participating spray foam enterprises including provide advice on a preparation of EMP.
- Together with GSB review and assess the adequacy of the HCFC conversion plan including the EMP of participating enterprises.
- Supervise the implementation of the HCFC conversion project and the enterprise's compliance with the agreed environmental and safety requirements and standards.
- Prepare biannually project safeguards progress report that provide overview of project safeguards implementation status and performance and share with the World Bank in each Project Implementation Support Mission (ISM).

10.3 The Government Saving Bank (GSB)

- Review and assess the adequacy of the HCFC conversion plan including the EMP of participating enterprises.
- Include the approved EMP in the sub-grant agreement with each participating spray foam enterprise such that the responsibilities and commitments in the EMP become contractual obligations of the participating enterprise.

11. Training and capacity building for EMF Implementation

It is the responsibility of the participating foam enterprise to ensure that their employees receive adequate training to perform their works safely. The trainings should cover basic safety training and use of PPE, proper storage, handling and disposal of blowing agents and chemicals as well as health, safety and environmental requirements as indicated in the EMP forms. Part of conversion cost to be financed by the project could be used for training including these required trainings.

12. Technical Assistance for Participating Spray Foam Enterprises

In addition to the project financial support to spray foam enterprises which part of the cost can be used for training, the PMU and its technical consultant will be available to provide advice to participating foam enterprises on technical aspects and EMP. The technical consultant to be hired by the PMU will be fully familiar with the HCFC conversion process, including the handling of blowing agents and other chemicals, health and fire hazards and mitigating measures.

13. Grievance Redress Mechanisms (GRM)

Communities and individuals who believe that they are adversely affected by the project may submit complaints to existing DIW's Grievance Redress Mechanism and GSB's Grievance Redress Mechanism through various channels include walk-in, fax, phone call, hotline, website, email, etc. Furthermore, there are several other channels in which affected individual or communities can submit complaints/suggestions including GRM available at the Prime Minister Office, Pollution Control Department, Federal Thai Institute, etc. as well as the World Bank's Grievance Redress Service (GRS) system.

14. Budget for EMF/EMP implementation

Participating spray foam enterprises bear the financial responsibility for the conversion including any environmental, social health and safety mitigation activities required by the EMF/EMP. The project will make an agreed payment to participating spray foam enterprises to convert to low-GWP HFO alternatives which will cover cost for: (i) handling and storage for HFOs and new foam systems; (ii) trial production and training of spray foam enterprises; and (iii) incremental operating cost of the alternative technologies for a transitional period. The cost of hiring the technical consultant by the PMU will be borne by the HCFC Phase-out Stage II Project.

15. Stakeholders Consultations

Stakeholder consultation meeting on the draft EMF was held at the DIW on June 19, 2019 with participants from relevant stakeholders including spray foam enterprises, chemicals suppliers, and other interest stakeholders (Annex F). Objectives of the meeting is to present to stakeholders on: i) the project scope and objectives, activities; ii) draft EMF and its proposed measures; and iii) discuss and hear feedbacks from stakeholders for incorporating into the final EMF where appropriate.

The main suggestions are as follows:

1. Attachment 04 the work procedure should be clearly classified into each step such as equipment inspection, maintenance of equipment and personal protective equipment (PPEs), and training on safe working practice with chemicals.

2. Measures for working in poor ventilation areas should be separated into 2 scenarios including i) confined space according to regulatory requirements and ii) attics or crawlspaces.

3. For working in confined space e.g. tank or silo, enterprises need to make sure that their employees are trained on working in confined space and strictly follow the requirements for safe works. For works in attics or crawlspaces that has poor ventilation, temporary opening at a roof and other places as well as installation of suction fan to encourage air flow should be provided. Works rotation for example every 20-30 minutes should be practiced to limited employee exposure to challenging works conditions.

4. Most of foam spraying works are carried out in attics where chemical mask and safety goggles can easily clogged by spray foam. In such case, operators use plastic to cover to minimize damage to PPEs.

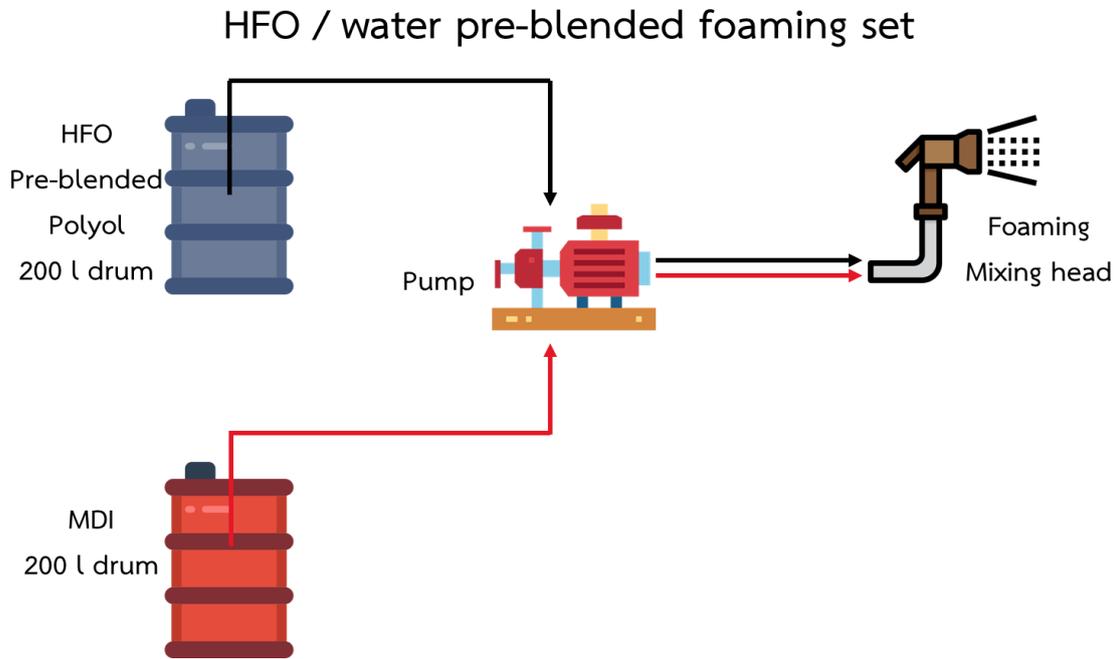
5. Chemical protective clothing that is currently sold in a market is from foreign countries, which is not suitable for the context of Thailand e.g. climate. Operators prefer to wear long sleeves shirt and long trouser that are suitable with local climate.

6. Request for the World Bank support on trainings and provision of necessary PPEs.

ANNEX

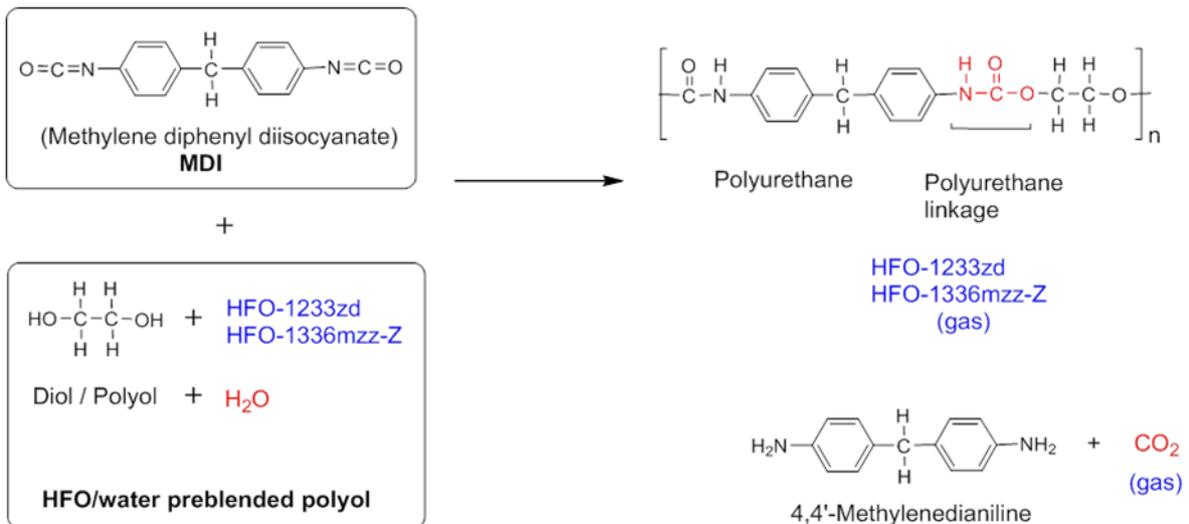
ANNEX A Schematic diagram of a spray foam unit and Chemical formula

Schematic diagram of a spray foam unit



Chemical formula

HFO/water Preblended Polyol



ANNEX B Safety Data Sheet

HFO-1233zd

Solstice® LBA (HFO-1233zd)

000000012786

Version 1.16

Revision Date 06/16/2014

Print Date 07/22/2015

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	Solstice® LBA
MSDS Number	000000012786
Product Use Description	Foam blowing agent
Manufacturer or supplier's details	Honeywell International Inc. 101 Columbia Road Morristown, NJ 07962-1057
For more information call	800-522-8001 +1-973-455-6300 (Monday-Friday, 9:00am-5:00pm)
In case of emergency call	Medical: 1-800-498-5701 or +1-303-389-1414 Transportation (CHEMTREC): 1-800-424-9300 or +1-703-527-3887 (24 hours/day, 7 days/week)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Form	liquid, clear
Color	colourless
Odor	slight

Classification of the substance or mixture

Classification of the substance or mixture	Gases under pressure, Liquefied gas Simple Asphyxiant
--	--

GHS Label elements, including precautionary statements

Symbol(s)



Signal word	Warning
Hazard statements	Contains gas under pressure; may explode if heated. May displace oxygen and cause rapid suffocation.

Precautionary statements Prevention:
Use personal protective equipment as required.
Storage:
Protect from sunlight. Store in a well-ventilated place

Carcinogenicity

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature

Substance

Chemical Name	CAS-No	Concentration
trans-1-Chloro-3,3,3-trifluoropropene	102687-65-0	>99.00 %

SECTION 4. FIRST AID MEASURES

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Use oxygen as required, provided a qualified operator is present. Call a physician.

Skin contact: After contact with skin, wash immediately with plenty of water. If symptoms persist, call a physician. Take off all contaminated clothing immediately. Wash contaminated clothing before reuse

Eye contact: Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician if irritation develops or persists.

Ingestion: If victim is fully conscious, give a cupful of water. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Call a physician immediately.

Notes to physician

Treatment: Treat symptomatically.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media The product is not flammable.

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Water spray

Carbon dioxide (CO₂)

Dry chemical

Foam

Specific hazards during firefighting

This product is not flammable at ambient temperatures and atmospheric pressure

However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources.

Container may rupture on heating.

Cool closed containers exposed to fire with water spray.

Do not allow run-off from firefighting to enter drains or water courses.

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Exposure to decomposition products may be a hazard to health.

In case of fire hazardous decomposition products may be produced such as:

Hydrogen fluoride

Gaseous hydrogen chloride (HCl).

Carbon monoxide

Carbon dioxide (CO₂)

Carbonyl halides

Special protective
equipment for firefighters

In the event of fire and/or explosion do not breathe fumes

Wear self-contained breathing apparatus and protective suit.

No unprotected exposed skin areas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Immediately evacuate personnel to safe areas.

Keep people away from and upwind of spill/leak.

Wear personal protective equipment. Unprotected persons must be kept away.

Remove all sources of ignition.

Ventilate the area.

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Avoid accumulation of vapours in low areas.

Unprotected personnel should not return until air has been tested and determined safe.

Ensure that the oxygen content is $\geq 19.5\%$.

Environmental precaution:

Do not flush into surface water or sanitary sewer system.

Prevent further leakage or spillage if safe to do so.

Prevent spreading over a wide area (e.g. by containment or oil barriers).

Methods for cleaning up:

Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

SECTION 7. HANDLING AND STORAGE

Handling

Handling

Handle with care.

Do not use in areas without adequate ventilation.

Do not breathe vapours or spray mist.

Avoid contact with skin, eyes and clothing.

Follow all standard safety precautions for handling and use of compressed gas cylinders.

Use authorized cylinders only.

Protect cylinders from physical damage.

Do not puncture or drop cylinders, expose them to open flame or excessive heat.

Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.

Do not remove screw cap until immediately ready for use.

Always replace cap after use.

Advice on protection against fire and explosion

Can form a combustible mixture with air at pressures above atmospheric pressure.

Keep product and empty container away from heat and sources of ignition.

Storage

Requirements for storage areas and containers

Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 55 °C.

Keep containers tightly closed in a dry, cool and well-ventilated place.

Storage rooms must be properly ventilated.

Ensure adequate ventilation, especially in confined areas.

Protect cylinders from physical damage.

Store away from incompatible substances.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective measures	Ensure that eyewash stations and safety showers are close to the workstation location. Do not breathe vapours or spray mist. Avoid contact with skin, eyes and clothing.
Engineering measures	Use with local exhaust ventilation. Perform filling operations only at stations with exhaust ventilation facilities.
Eye protection	Do not wear contact lenses. Wear as appropriate: Goggles or face shield, giving complete protection to eyes
Hand protection	Impervious gloves Gloves must be inspected prior to use. Replace when worn.
Skin and body protection	Wear as appropriate: Solvent-resistant gloves Solvent-resistant apron and boots If splashes are likely to occur, wear: Protective suit
Respiratory protection	In case of insufficient ventilation wear suitable respiratory equipment. Wear a positive-pressure supplied-air respirator. For rescue and maintenance work in storage tanks use selfcontained breathing apparatus. Use NIOSH approved respiratory protection.
Hygiene measures	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing. Do not breathe vapours or spray mist. Ensure adequate ventilation, especially in confined areas. Remove and wash contaminated clothing before re-use. Contaminated work clothing should not be allowed out of the workplace. Keep working clothes separately. Wash hands before breaks and immediately after handling the product.

Exposure Guidelines

Components	CAS-No.	Value	Control parameters	Update	Basis
trans-1-Chloro-3,3,3-trifluoropropene	102687-65-0	TWA : time weighted average	(800 ppm)	2013	WEEL: OARS -Workplace Environmental Exposure Level (WEEL) Guides
trans-1-Chloro-3,3,3-trifluoropropene	102687-65-0	TWA : time weighted average	(800 ppm)	2013	Honeywell:Limit established by Honeywell International Inc.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state	liquid, clear
Color	colourless
Odor	slight
Melting point/freezing point	< -90 °C Method: OECD Test Guideline 102
Boiling point/boiling range	19 °C
Flash point	Method: ISO 2719 Note: not applicable
Flammability	The product is not flammable. Method: Flammability (gases)
Lower explosion limit	Note: None
Upper explosion limit	Note: None
Vapor pressure	1,516 hPa at 30 °C(86 °F)
Vapor density	Note: (Air = 1.0), not determined
Density	1.27 g/cm ³
Water solubility	1.90 g/l at 20 °C Method: OECD Test Guideline 105
Partition coefficient: noctanol/water	log Pow: 2.2 at 25 °C
Ignition temperature	380 °C at 986.8 - 1,035.9 hPa Method: DIN 51794
Oxidizing properties	The substance or mixture is not classified as oxidizing.
Molecular weight	130.5 g/mol

SECTION 10. STABILITY AND REACTIVITY

Chemical stability	Stable under recommended storage conditions.
Possibility of hazardous reactions	Polymerization can occur.
Conditions to avoid	Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 55 °C. Can form a combustible mixture with air at pressures above atmospheric pressure. Do not mix with oxygen or air above atmospheric pressure.
Incompatible materials to avoid	Strong oxidizing agents Finely divided magnesium Finely divided aluminium
Hazardous decomposition products	In case of fire hazardous decomposition products may be produced such as: Carbon monoxide Carbon dioxide (CO ₂) Carbonyl halides Gaseous hydrogen chloride (HCl). Gaseous hydrogen fluoride (HF)

SECTION 11. TOXICOLOGICAL INFORMATION

Acute inhalation toxicity	LC50: 120000 ppm Exposure time: 4 h Species: rat
Skin irritation	Species: rabbit Result: No skin irritation Classification: Not classified as a skin irritant in animal testing. Method: OECD Test Guideline 404 Exposure time: 4 h
Sensitisation	Result: Does not cause skin sensitisation. Classification: Patch test on human volunteers did not demonstrate sensitisation properties. Cardiac sensitization Species: dogs Note: Cardiac sensitisation threshold (dog): 25000 ppm.
Repeated dose toxicity	Species: rat Application Route: Inhalation Exposure time: 4 Weeks

	NOEL: 4500 ppm
	Note: Subacute toxicity
Genotoxicity in vitro	Test Method: Mutagenicity (Salmonella typhimurium – reverse mutation assay)
	Result: negative
Genotoxicity in vivo	Species: rat
	Cell type: Bone marrow
	Method: Mutagenicity (micronucleus test)
	Result: negative
Genotoxicity in vivo	Test Method: Unscheduled DNA synthesis
	Species: rat
	Result: negative
Genotoxicity in vivo	Species: mouse
	Cell type: Bone marrow
	Method: Mutagenicity (micronucleus test)
	Result: negative
Reproductive toxicity	Species: rabbit
	Note: No-observed-effect level - 15,000 ppm
	Species: rat
	Note: No-observed-effect level - 10,000 ppm
Teratogenicity	Species: rabbit
	Note: No-observed-effect level - 15,000 ppm
	Species: rat
	Note: No-observed-effect level - 10,000 ppm
Further information	Note: Excessive exposure may cause central nervous system effects including drowsiness and dizziness. Excessive exposure may also cause cardiac arrhythmia.

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Toxicity to fish	LC50: 38 mg/l
	Exposure time: 96 h
	Species: Oncorhynchus mykiss (rainbow trout)
	Method: OECD Test Guideline 203
Toxicity to daphnia and other aquatic invertebrates	Immobilization
	EC50: 82 mg/l
	Exposure time: 48 h

Toxicity to algae	Species: Daphnia magna (Water flea)
	Method: OECD Test Guideline 202
	Growth inhibition
	EC50: 106.7 mg/l
	Exposure time: 72 h
	Species: Pseudokirchneriella subcapitata (green algae)
Toxicity to algae	Method: OECD Test Guideline 201
	Growth rate
	NOEC: 115 mg/l
	Exposure time: 72 h
	Species: Pseudokirchneriella subcapitata (green algae)
	Method: OECD Test Guideline 201

Elimination information (persistence and degradability)

Biodegradability	Result: Not readily biodegradable.
	Value: 0 %
	Method: OECD 301 D

Further information on ecology

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods	Observe all Federal, State, and Local Environmental regulations.
Note	Where possible recycling is preferred to disposal or incineration.

SECTION 14. TRANSPORT INFORMATION

DOT	UN/ID No.	UN 3163
	Proper shipping name	LIQUEFIED GAS, N.O.S. (Trans-1-Chloro-3,3,3-trifluoropropene)
	Class	2.2
	Packing group	
	Hazard Labels	2.2
IATA	UN/ID No.	UN 3163
	Description of the goods	LIQUEFIED GAS, N.O.S. (Trans-1-Chloro-3,3,3-trifluoropropene)
	Class	2.2
	Hazard Labels	2.2
	Packing instruction (cargo aircraft)	200
	Packing instruction (passenger aircraft)	200
IMDG	UN/ID No.	UN 3163

Description of the goods	LIQUEFIED GAS, N.O.S. (TRANS-1-CHLORO-3,3,3 TRIFLUOROPROPENE)
Class	2.2
Hazard Labels	2.2
EmS Number	F-C, S-V
Marine pollutant	no

SECTION 15. REGULATORY INFORMATION

Inventories

US. Toxic Substances Control Act	On TSCA Inventory
Australia. Industrial Chemical (Notification and Assessment) Act	On the inventory, or in compliance with the inventory
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL)	All components of this product are on the Canadian DSL.
Japan. Kashin-Hou Law List	On the inventory, or in compliance with the inventory
Korea. Toxic Chemical Control Law (TCCL) List	On the inventory, or in compliance with the inventory
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	Not in compliance with the inventory
	trans-1-Chloro-3,3,3-trifluoropropene 102687-65-0
China. Inventory of Existing Chemical Substances	On the inventory, or in compliance with the inventory
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	Not in compliance with the inventory
	trans-1-Chloro-3,3,3-trifluoropropene 102687-65-0

National regulatory information

SARA 302 Components	SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.
SARA 313 Components	SARA 313: This material does not contain any chemical

	components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
SARA 311/312 Hazards	Acute Health Hazard Sudden Release of Pressure Hazard
California Prop. 65	This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.
New Jersey RTK	trans-1-Chloro-3,3,3-trifluoropropene 102687-65-0
Pennsylvania RTK	trans-1-Chloro-3,3,3-trifluoropropene 102687-65-0
WHMIS Classification	A: Compressed Gas This product has been classified according to the hazard criteria of the CPR and the MSDS contains all of the information required by the CPR

SECTION 16. OTHER INFORMATION

	HMIS III	NFPA
Health hazard	2	2
Flammability	0	0
Physical Hazard	0	
Instability		0

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.

Previous Issue Date: 01/06/2014

Prepared by Honeywell Performance Materials and Technologies Product Stewardship Group

Substance name: (Z)-1,1,1,4,4,4-Hexafluoro-2-butene
 CAS-No.: 692-49-9

Components

Chemical name	CAS-No.	Concentration (% w/w)
(Z)-1,1,1,4,4,4-Hexafluoro-2-butene*	692-49-9	>= 90 -<= 100

* Voluntarily-disclosed non-hazardous substance

4. FIRST AID MEASURES

If inhaled:	If inhaled, remove to fresh air. Get medical attention if symptoms occur.
In case of skin contact:	Wash with water and soap as a precaution. Get medical attention if symptoms occur.
In case of eye contact:	Flush eyes with water as a precaution. Get medical attention if irritation develops and persists.
If swallowed:	If swallowed, DO NOT induce vomiting. Get medical attention if symptoms occur. Rinse mouth thoroughly with water.
Most important symptoms and effects, both acute and delayed	May cause cardiac arrhythmia. Other symptoms potentially related to misuse or inhalation abuse are Cardiac sensitisation Anaesthetic effects Light-headedness Dizziness confusion Lack of coordination Drowsiness Unconsciousness
Protection of first-aiders:	No special precautions are necessary for first aid responders.
Notes to physician:	Treat symptomatically and supportively.

5. FIREFIGHTING MEASURES

Suitable extinguishing media:	Not applicable Will not burn
Unsuitable extinguishing media:	Not applicable Will not burn

Specific hazards during firefighting:	Exposure to combustion products may be a hazard to health.
Hazardous combustion products:	Hydrogen fluoride carbonyl fluoride Carbon oxides
Specific extinguishing methods:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Remove undamaged containers from fire area if it is safe to do so. Evacuate area.
Special protective equipment: for firefighters	Wear self-contained breathing apparatus for firefighting if necessary. Use personal protective equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective: equipment and emergency procedures	Follow safe handling advice and personal protective equipment recommendations.
Environmental precautions:	Discharge into the environment must be avoided. Prevent further leakage or spillage if safe to do so. Prevent spreading over a wide area (e.g. by containment or oil barriers). Retain and dispose of contaminated wash water. Local authorities should be advised if significant spillages cannot be contained.
Methods and materials for: containment and cleaning up	Soak up with inert absorbent material. For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can be pumped, store recovered material in appropriate container. Clean up remaining materials from spill with suitable absorbent. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable.

Sections 13 and 15 of this SDS provide information regarding certain local or national requirements

7. HANDLING AND STORAGE

Technical measures:	See Engineering measures under EXPOSURE CONTROLS/PERSONAL PROTECTION section.
Local/Total ventilation:	Use only with adequate ventilation.
Advice on safe handling:	<p>Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment.</p> <p>Take care to prevent spills, waste and minimize release to the environment.</p> <p>Valve protection caps and valve outlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point.</p> <p>Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.</p> <p>Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems.</p> <p>Never attempt to lift cylinder by its cap.</p> <p>Do not drag, slide or roll cylinders.</p> <p>Use a suitable hand truck for cylinder movement.</p>
Conditions for safe storage:	<p>Cylinders should be stored upright and firmly secured to prevent falling or being knocked over.</p> <p>Separate full containers from empty containers.</p> <p>Do not store near combustible materials.</p> <p>Avoid area where salt or other corrosive materials are present.</p> <p>Do not expose drums to direct heat or temperature above 46°C (115°F) to avoid pressurizing and possibly distorting the drums.</p> <p>Material should not be dispensed by pouring from pail/drum shipping containers containing 5 gallons or more. The use of a drum pump is recommended for dispensing from pail/drum shipping containers with 5 gallons or more, except for smaller containers where adequate ventilation can be used to manage the exposure.</p> <p>Keep in properly labelled containers.</p> <p>Store in accordance with the particular national regulations.</p>

Materials to avoid: No special restrictions on storage with other products.
Recommended storage temperature: < 46 °C
Storage period: > 10 yr
Further information on storage stability: The product has an indefinite shelf life when stored properly.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

Engineering measures

Ensure adequate ventilation, especially in confined areas.

Minimize workplace exposure concentrations.

Personal protective equipment

Respiratory protection: Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines.

Filter type: Organic gas and low boiling vapour type

Hand protection

Material: Low temperature resistant gloves

Remarks: Choose gloves to protect hands against chemicals depending on the concentration and quantity of the hazardous substance and specific to place of work. For special applications, we recommend clarifying the resistance to chemicals of the aforementioned protective gloves with the glove manufacturer. Wash hands before breaks and at the end of workday. Breakthrough time is not determined for the product. Change gloves often!

Eye protection: Wear the following personal protective equipment:
Safety glasses

Skin and body protection: Skin should be washed after contact.

Hygiene measures: Ensure that eye flushing systems and safety showers are located close to the working place.
When using do not eat, drink or smoke.
Wash contaminated clothing before re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: liquid
Colour: clear, colourless
Odour: odourless

Odour Threshold:	No data available
pH:	7.4 (20 °C)
Melting point/freezing point:	No data available
Initial boiling point and Boiling range:	33 °C
Flash point:	Method: ASTM D 56 boils before flash
Evaporation rate:	No data available
Flammability (solid, gas):	Not applicable
Flammability (liquids):	Will not burn
Upper explosion limit/:	Upper flammability limit
Upper flammability limit	Method: ASTM E681 None.
Lower explosion limit/:	Lower flammability limit
Lower flammability limit	Method: ASTM E681 None.
Vapour pressure:	604.35 hPa (20 °C)
Relative vapour density:	No data available
Density:	1.4 g/cm ³ (20 °C) (as liquid)
Solubility(ies)	
Water solubility:	0.7633 g/l (25 °C)
Partition coefficient: n: octanol/water	log Pow: 2.3 (30 °C)
Auto-ignition temperature:	No data available
Decomposition temperature:	No data available
Viscosity	
Viscosity, kinematic:	No data available
Explosive properties:	Not explosive
Oxidizing properties:	The substance or mixture is not classified as oxidizing.
Particle size:	Not applicable

10. STABILITY AND REACTIVITY

Reactivity:	Not classified as a reactivity hazard.
Chemical stability:	Stable under normal conditions.
Possibility of hazardous reactions:	None known.
Conditions to avoid:	None known.
Incompatible materials:	None.
Hazardous decomposition products:	No hazardous decomposition products are known.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	Inhalation Skin contact
---	----------------------------

Ingestion
Eye contact

Acute toxicity

Not classified based on available information.

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Acute inhalation toxicity: LC50 (Rat): > 690.413 mg/l

Exposure time: 4 h

Test atmosphere: vapour

Method: OECD Test Guideline 403

No observed adverse effect concentration (Dog): 12500 ppm

Test atmosphere: gas

Lowest observed adverse effect concentration (Dog): 25000 ppm

Test atmosphere: gas

Cardiac sensitisation threshold limit (Dog): 1,677,740 mg/m³

Test atmosphere: gas

Skin corrosion/irritation

Not classified based on available information.

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Result: No skin irritation

Serious eye damage/eye irritation

Not classified based on available information.

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Result: No eye irritation

Respiratory or skin sensitisation

Skin sensitisation

Not classified based on available information.

Respiratory sensitisation

Not classified based on available information.

Germ cell mutagenicity

Not classified based on available information.

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Genotoxicity in vitro: Test Type: Bacterial reverse mutation assay (AMES)

Method: OECD Test Guideline 471

Result: negative

Test Type: Chromosome aberration test in vitro

Method: OECD Test Guideline 473

Result: negative

Genotoxicity in vivo: Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay)

Method: OECD Test Guideline 474

Result: negative

Germ cell Mutagenicity: Weight of evidence does not support classification as a
Assessment germ cell mutagen.

Carcinogenicity

Not classified based on available information.

Reproductive toxicity

Not classified based on available information.

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Effects on fertility Test Type: Two-generation reproduction toxicity study
Species: Rat

Application Route: inhalation (vapour)

Method: OECD Test Guideline 416

Result: negative

Effects on foetal Test Type: Embryo-foetal development
development Species: Rabbit

Application Route: inhalation (vapour)

Method: OECD Test Guideline 414

Result: negative

Reproductive toxicity – Weight of evidence does not support classification for
Assessment reproductive toxicity

STOT - single exposure

Not classified based on available information.

STOT – repeated exposure

Not classified based on available information.

Repeated dose toxicity

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Species Rat, male

NOAEL 33.5 mg/l

Application Route	inhalation (vapour)
Exposure time	90 Days
Method	OECD Test Guideline 413

Aspiration toxicity

Not classified based on available information.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Toxicity to fish	LC50 (<i>Oryzias latipes</i> (Japanese medaka)): 76.1 mg/l Exposure time: 96 h Method: OECD Test Guideline 203
Toxicity to daphnia and other aquatic invertebrates	EC50 (<i>Daphnia magna</i> (Water flea)): 22.5 mg/l Exposure time: 48 h Method: OECD Test Guideline 202
Toxicity to algae	ErC50 (<i>Pseudokirchneriella subcapitata</i> (green algae)): > 23.7 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 NOEC (<i>Pseudokirchneriella subcapitata</i> (green algae)): 6.92 mg/l Exposure time: 72 h Method: OECD Test Guideline 201
Toxicity to fish (Chronic toxicity)	NOEC (<i>Gobiocypris rarus</i> (rare gudgeon)): 10 mg/l Exposure time: 32 d Method: OECD Test Guideline 210
Toxicity to daphnia and Other aquatic invertebrates (Chronic toxicity)	NOEC (<i>Daphnia magna</i> (Water flea)): 10 mg/l Exposure time: 21 d Method: OECD Test Guideline 211

Persistence and degradability

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Biodegradability	Result: Not readily biodegradable.
------------------	------------------------------------

Bioaccumulative potential

Components:

(Z)-1,1,1,4,4,4-Hexafluoro-2-butene:

Partition coefficient n-octanol/water	log Pow: 2.3
---------------------------------------	--------------

Mobility in soil

No data available

Other adverse effects

Product:

Results of PBT and vPvB
assessment

This substance is not considered to be persistent, bioaccumulating and toxic (PBT). This substance is not considered to be very persistent and very bioaccumulating (vPvB)

13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues

Dispose of in accordance with local regulations.

Contaminated packaging

Empty containers should be taken to an approved waste handling site for recycling or disposal.

If not otherwise specified: Dispose of as unused product.

14. TRANSPORT INFORMATION

International Regulations

UNRTDG

Not regulated as a dangerous good

IATA-DGR

Not regulated as a dangerous good

IMDG-Code

Not regulated as a dangerous good

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

Hazardous Substance Act B.E. 2535 (Z)-1,1,1,4,4,4-Hexafluoro-2-butene

Emergency Decree on Controlling the Use of Volatile Substances B.E. 2533 Not applicable

16. OTHER INFORMATION

Other information

Opteon™ and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC.

Chemours™ and the Chemours Logo are trademarks of The Chemours Company.

Before use read Chemours safety information.

For further information contact the local Chemours office or nominated distributors

CARBON DIOXIDE (CO₂)

1. PRODUCT AND COMPANY IDENTIFICATION

Catalogue No 823269
Product name Carbon dioxide for synthesis

Manufacturer/supplier identification

Company Merck Ltd.
9th Floor, Monterey Tower, 2170 New Petchburi Road, Bangkok,
Huaykwang, Bangkok 10320
Tel: (662) 308 - 0218

2. HAZARDS IDENTIFICATION

CAS-No	124-38-9	EC-Index-No	-
Molar mass	44.01	EINECS-No.	204-696-9
Molecular formula	CO ₂		

3. COMPOSITION/INFORMATION ON INGREDIENTS

According to the evaluative data available, a classification according to categories of danger as specified in Directive 67/548/EEC and laid down in the legislation of the country concerned is not required.

4. FIRST AID MEASURES

After inhalation: fresh air. If necessary, apply mouth-to-mouth resuscitation or mechanical ventilation. If victim is unconscious: lateral recumbent position.

5. FIREFIGHTING MEASURES

Suitable extinguishing media: In adaption to materials stored in the immediate neighborhood. Cool containers with water.

Other information: Non-combustible.

6. ACCIDENTAL RELEASE MEASURES

Stop flow of gas, move leaking cylinder to open air if without risk.

7. HANDLING AND STORAGE

Handling: No further requirements.
Storage: tightly closed, in a well-ventilated place

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Specific control parameter

MAK Germany (max. workplace conc.)

Carbon dioxide 5000 ml/m³ or 9100 mg/m³

13. DISPOSAL CONSIDERATIONS

- Product:** There are no uniform EC Regulations for the disposal of chemicals or residues. Chemical residues generally count as special waste. The disposal of the latter is regulated in the EC member countries through corresponding laws and regulations. We recommend that you contact either the authorities in charge or approved waste disposal companies which will advise you on how to dispose of special waste.
- Packaging:** Disposal in compliance with official regulations. Handle contaminated packaging in the same way as the substance itself. If not officially specified differently, non-contaminated packaging may be treated like household waste or recycled.

14. TRANSPORT INFORMATION

Transport over land ADR/RID and GGVS/GGVE (Germany)

GGVS/GGVE class:	2	Number and letter:
ADR/RID class:	2	Number and letter:
Name of material:	1013 KOHLENDIOXID	

River transport ADN/ADNR
not examined

Sea transport IMDG

IMDG class:	2.2	
UN-No.:	1013	Packaging group:
Ems:	2-09	MFAG: 615
Correct technical name:	CARBON DIOXIDE	

Air transport ICAO-TI and IATA-DGR

ICAO/IATA class:	2.2	
UN/ID-No.:	1013	Packaging group:
Correct technical name:	CARBON DIOXIDE	

The transport regulations are cited according to international regulations and in the form applicable in Germany (GGVS/GGVE). Possible national deviations in other countries are not considered.

15. REGULATORY INFORMATION

Labelling according to EC Directives

R-phrases:	---	
S-phrases:	S 3-7	Keep in a cool place. Keep container tightly closed.

German regulations

Water pollution class	0	(generally nonpolluting substance)
-----------------------	---	------------------------------------

16. OTHER INFORMATION

no information available

Polyol

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifier

Trade name: Hilti Firestop Foam CFS-F FX
CP 660

1.2 Relevant identified uses of the substance or mixture and uses advised against

No further relevant information available.

Application of the substance / the mixture Construction chemicals

1.3 Details of the supplier of the safety data sheet

Manufacturer/Supplier:

Hilti (Gt. Britain) Ltd.
1 Trafford Wharf Road
Trafford Park
GB-M17 1BY Manchester
Phone: 0800 886 100 (Freephone)
Fax: 0800 886 200 (Freefax)
Email: gbsales@hilti.com

Informing department:

chemicals.hse@hilti.com
see section 16

1.4 Emergency telephone number:

Hilti (Gt. Britain) Ltd
Phone: 0800 886 100 (Freephone)
Fax: 0800 886 200 (Freefax)
Schweizerisches Toxikologisches Informationszentrum - 24 h Service
Tel.: 0041 / 44 251 51 51 (international)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008



GHS08 health hazard

Resp. Sens. 1 H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carc. 2 H351 Suspected of causing cancer.

STOT RE 2 H373 May cause damage to organs through prolonged or repeated exposure.



GHS07

- Skin Irrit. 2 H315 Causes skin irritation.
Eye Irrit. 2 H319 Causes serious eye irritation.
Skin Sens. 1 H317 May cause an allergic skin reaction.
STOT SE 3 H335 May cause respiratory irritation.

Signal word Danger

Hazard-determining components of labelling:

methylenediphenyl diisocyanate, ethylenediamine, ethoxylated and proxylated

Hazard statements

- H315 Causes skin irritation.
H319 Causes serious eye irritation.
H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317 May cause an allergic skin reaction.
H351 Suspected of causing cancer.
H335 May cause respiratory irritation.
H373 May cause damage to organs through prolonged or repeated exposure.

Precautionary statements

- P260 Do not breathe vapours.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P285 In case of inadequate ventilation wear respiratory protection.
P302+P352 IF ON SKIN: Wash with plenty of soap and water.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes.
Remove contact lenses, if present and easy to do. Continue rinsing.
P342+P311 If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.

Additional information:

Contains isocyanates. May produce an allergic reaction.

2.2 Other hazards

Results of PBT and vPvB assessment

PBT: Not applicable.

vPvB: Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

components:

CAS: 26316-40-5

Reg.nr.: 01-2119471488-26

ethylenediamine, ethoxylated and proxylated

CAS: 25214-63-5
Reg.nr.: 01-2119471485-32
ehylenediamine, ethoxylated

4. FIRST AID MEASURES

4.1 Description of first aid measures

General information	Instantly remove any clothing soiled by the product.
After inhalation	Take affected persons into the open air and position comfortably Seek medical treatment in case of complaints.
After skin contact	Instantly wash with water and soap and rinse thoroughly. If skin irritation persists, call a physician. If skin irritation continues, consult a doctor.
After eye contact	Rinse opened eye for several minutes under running water. If symptoms persist, consult doctor.
After swallowing	Seek immediate medical advice.

4.2 Most important symptoms and effects, both acute and delayed Allergic reactions

4.3 Indication of any immediate medical attention and special treatment needed No further relevant information available.

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing agents Water spray, carbon dioxide (CO₂), carbon dioxide blanket, foam, or dry powder.

5.2 Special hazards arising from the substance or mixture

Can be released in case of fire
Carbon monoxide (CO)
Carbon dioxide (CO₂)
Nitrogen oxides (NO_x)

5.3 Advice for firefighters

Protective equipment: Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear protective clothing.
Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition.

Particular danger of slipping on leaked/spilled product.

6.2 Environmental precautions: Do not allow product to reach sewage system or water bodies.

6.3 Methods and material for containment and cleaning up:

Collect mechanically.

Dispose of contaminated material as waste according to item 13.

Ensure adequate ventilation.

6.4 Reference to other sections

See Section 8 for information on personal protection equipment.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Provide sufficient air exchange and/or exhaust in work rooms. When using, do not eat, drink or smoke. Ingestion, exposure to skin and eyes and inhalation of any general vapours should be avoided.

7.2 Conditions for safe storage, including any incompatibilities

Storage

Requirements to be met by storerooms and containers: Keep packaging securely closed and dry, store at 5 °C to 25 °C.

Information about storage in one common storage facility: Store away from foodstuffs.

Further information about storage conditions:

Store in a locked cabinet or with access restricted to technical experts or their assistants.

Store container in a well ventilated position.

Protect from heat and direct sunlight.

· 7.3 Specific end use(s) No further relevant information available.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Additional information about design of technical systems: No further data; see item 7.

8.1 Control parameters

Components with limit values that require monitoring at the workplace:

9016-87-9 4,4'-diphenylmethanediisocyanate, isomeres and homologues

MEL Short-term value: 0.07 mg/m³

Long-term value: 0.02 mg/m³

Sen; as -NCO

8.2 Exposure controls

Personal protective equipment

General protective and hygienic measures

The usual precautionary measures should be adhered to general rules for handling chemicals.

Do not inhale gases / fumes / aerosols.

Wash hands during breaks and at the end of the work.

Keep away from foodstuffs, beverages and food.

Avoid contact with the eyes and skin.

Breathing equipment:

Not necessary if room is well-ventilated.

Use breathing protection in case of insufficient ventilation.

Protection of hands:

Protective gloves

EN 374 The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

Material of gloves

Synthetic gloves

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

Penetration time of glove material

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

Eye protection:

Tightly sealed safety glasses.

EN 166 + EN 170

Body protection:

Protective work clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

General Information

Appearance:

Form: Fluid

Colour: Red

Odour: Characteristic

Change in condition

Melting point/Melting range: Not determined

Boiling point/Boiling range: Not determined

Flash point: Not applicable
Self-inflammability: Product is not selfigniting.
Danger of explosion: Product is not explosive.
Density Not determined
Solubility in / Miscibility with
Water: Not miscible or difficult to mix

9.2 Other information No further relevant information available.

10. STABILITY AND REACTIVITY

10.1 Reactivity

10.2 Chemical stability

Thermal decomposition / conditions to be avoided: No decomposition if used according to specifications.

10.3 Possibility of hazardous reactions Reacts with water

10.4 Conditions to avoid No further relevant information available.

10.5 Incompatible materials: No further relevant information available.

10.6 Hazardous decomposition products: none, if stored and handled correctly.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity:

9016-87-9 4,4'-diphenylmethanediisocyanate, isomeres and homologues

Oral LD50 >5000 mg/kg (rat)

Inhalative LC50/4 h 0.49 mg/l (rat)

26316-40-5 ethylenediamine, ethoxylated and proxylated

Oral LD50 >5000 mg/kg (rat)

Dermal LD50 >5000 mg/kg (rat)

25214-63-5 ethylenediamine, ethoxylated

Oral LD50 >2000 mg/kg (rat)

Dermal LD50 >2000 mg/kg (rat)

Primary irritant effect:

on the skin: Irritant to skin and mucous membranes.

on the eye: Irritant effect.

Sensitization:

Sensitization possible by skin contact.

Sensitization possible by inhalation.

Additional toxicological information:

The product shows the following dangers according to the calculation method of the General EC Classification Guidelines for Preparations as issued in the latest version:

Harmful

CMR effects (carcinogenicity, mutagenicity and toxicity for reproduction)

Limited evidence of a carcinogenic effect.

Carc. 2

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Aquatic toxicity: No further relevant information available.

12.2 Persistence and degradability No further relevant information available.

12.3 Bioaccumulative potential No further relevant information available.

12.4 Mobility in soil No further relevant information available.

Ecotoxicological effects: Not determined

Additional ecological information:

General notes: Do not allow product to reach ground water, water bodies or sewage system.

12.5 Results of PBT and vPvB assessment

PBT: Not applicable.

vPvB: Not applicable.

12.6 Other adverse effects No further relevant information available.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Recommendation Must not be disposed of together with household garbage.

Do not allow product to reach sewage system.

European waste catalogue 08 04 09* waste adhesives and sealants containing organic solvents or other dangerous substances

Uncleaned packagings:

Recommendation: Disposal must be made according to official regulations.

Dispose of packaging according to regulations on the disposal of packagings.

Empty packs: May be disposed via the local Green Dot collecting system (valpak) or EAK waste material code 150102 (plastic packaging)

ISOCYANATE

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	4,4'-Methylenebis(phenyl isocyanate)
Product Number	256439
Brand	Aldrich
Index-No.	615-005-00-9
REACH No.	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	101-68-8

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Laboratory chemicals, Manufacture of substances
-----------------	---

1.3 Details of the supplier of the safety data sheet

Company	Sigma-Aldrich Pte Ltd (Co. Registration No. 199403788W) 1 Science Park Road #02-14 The Capricorn, S'pore Sci. PkII SINGAPORE 117528 SINGAPORE
Telephone	+65 6779-1200
Fax	+65 6779-1822

1.4 Emergency telephone number

Emergency Phone #	1-800-262-8200
-------------------	----------------

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Acute toxicity, Inhalation (Category 4), H332
Skin irritation (Category 2), H315
Eye irritation (Category 2), H319
Respiratory sensitisation (Category 1), H334
Skin sensitisation (Category 1), H317
Carcinogenicity (Category 2), H351
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Specific target organ toxicity - repeated exposure (Category 2), H373
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008



Pictogram

Signal word

Danger

Hazard statement(s)

H315 Causes skin irritation.

H317 May cause an allergic skin reaction.

H319 Causes serious eye irritation.

H332 Harmful if inhaled.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

H335 May cause respiratory irritation.

H351 Suspected of causing cancer.

H373 May cause damage to organs through prolonged or repeated exposure.

Precautionary statement(s)

P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

P284 Wear respiratory protection.

P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P342 + P311 If experiencing respiratory symptoms: Call a POISON CENTER/doctor.

Supplemental Hazard none

Statements

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher. Lachry mator.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms 4,4'-MDI Bis(4-i socyanatophenyl) methane

Formula $C_{15}H_{10}N_2O_2$

Molecular weight	250,25 g/mol
CAS-No.	101-68-8
EC-No.	202-966-0
Index-No.	615-005-00-9

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, Nitrogen oxides (NOx)

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Recommended storage temperature -20 °C
Handle and store under inert gas. Moisture sensitive. Heat sensitive.
Storage class (TRGS 510): 13: Non-Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.

Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact

Material: Nature latex/chloroprene

Minimum layer thickness: 0,6 mm

Break through time: 480 min

Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: 60 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole

means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU)

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a) Appearance	Form: crystalline Colour: white
b) Odour	No data available
c) Odour	Threshold No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 38 - 42 °C - lit.
f) Initial boiling point and boiling range	200 °C at 7 hPa - lit.
g) Flash point	113 °C - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	The product is not flammable. - Flammability (solids)
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	1,18 g/mL at 25 °C
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	> 601 °C at 1.013 hPa
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity No data available

10.2 Chemical stability Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions	No data available
10.4 Conditions to avoid	No data available
10.5 Incompatible materials	Water, Amines, Strong bases, Alcohols
10.6 Hazardous decomposition products	Hazardous decomposition products formed under fire conditions. - Carbon oxides, Nitrogen oxides (NOx) Other decomposition products - No data available. In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - 9.200 mg/kg

Remarks: Behavioral:Somnolence (general depressed activity). Behavioral:Ataxia.

Nutritional and Gross

Metabolic:Changes in:Body temperature decrease.

LC50 Inhalation - Rat - male and female - 1 h - > 2,24 mg/l
(OECD Test Guideline 403)

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

Eyes - Rabbit

Result: Moderate eye irritation

Respiratory or skin sensitization

in vivo assay - Guinea pig

Result: May cause sensitisation by inhalation.

in vivo assay - Mouse

Result: May cause sensitisation by skin contact.

Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects.

Ames test

S. typhimurium

Result: negative

Mutagenicity (micronucleus test)

Rat - male

Result: negative

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

Specific target organ toxicity - single exposure

Inhalation - May cause respiratory irritation. - Respiratory system

Specific target organ toxicity - repeated exposure

Inhalation - May cause damage to organs through prolonged or repeated exposure. – Respiratory system

Aspiration hazard

No data available

Additional Information

RTECS: NQ9350000

Cough, Shortness of breath, Headache, Nausea, Vomiting, Pulmonary edema. Effects may be delayed.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0,35 mg/l - 24 h (Diphenylmethane-4,4'- diisocyanate)
---	--

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

Bioaccumulation	Cyprinus carpio (Carp) - 28 d - 0,0008 mg/l(Diphenylmethane-4,4'-diisocyanate) Bioconcentration factor (BCF): 92
-----------------	--

12.4 Mobility in soil

No data available (Diphenylmethane-4,4'-diisocyanate)

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Do not empty into drains.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: -

IMDG: -

IATA: 3335

14.2 UN proper shipping name

ADR/RID: Not dangerous goods

IMDG: Not dangerous goods

IATA: Aviation regulated solid, n.o.s. (Diphenylmethane-4,4'-diisocyanate)

14.3 Transport hazard class(es)

ADR/RID: -

IMDG: -

IATA: 9

14.4 Packaging group

ADR/RID: -

IMDG: -

IATA: III

14.5 Environmental hazards

ADR/RID: no

IMDG Marine pollutant: no

IATA: no

14.6 Special precautions for user

No data available

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.2 Chemical safety assessment

For this product a chemical safety assessment was not carried out

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

H315 Causes skin irritation.

H317 May cause an allergic skin reaction.

H319 Causes serious eye irritation.

H332 Harmful if inhaled.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

H335 May cause respiratory irritation.

H351 Suspected of causing cancer.

H373 May cause damage to organs through prolonged or repeated exposure.

Further information

Copyright 2016 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigmaaldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

METHYLENE CHLORIDE

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	Methylene chloride
Product Number	M1550000
Brand	Sigma-Aldrich
REACH No.	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	75-09-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Laboratory chemicals, Manufacture of substances
-----------------	---

1.3 Details of the supplier of the safety data sheet

Company	Sigma-Aldrich Pte Ltd (Co. Registration No. 199403788W) 1 Science Park Road #02-14 The Capricorn, S'pore Sci. PkII SINGAPORE 117528 SINGAPORE
Telephone	+65 6779-1200
Fax	+65 6779-1822

1.4 Emergency telephone number

Emergency Phone # : 1-800-262-8200

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Skin irritation (Category 2), H315

Eye irritation (Category 2), H319

Carcinogenicity (Category 2), H351

Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

Specific target organ toxicity - repeated exposure, Oral (Category 2), Liver, Blood, H373

Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram



Signal word

Warning

Hazard statement(s)

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H373	May cause damage to organs (Liver, Blood) through prolonged or repeated exposure if swallowed.
H373	May cause damage to organs (Central nervous system) through prolonged or repeated exposure if inhaled.

Precautionary statement(s)

P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Supplemental Hazard Statements none

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulate and toxic (PBT), or very persistent and very bio accumulative (vPvB) at levels of 0.1% or higher

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	CH ₂ Cl ₂
Molecular weight	84.93 g/mol
CAS-No.	75-09-2

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component	Classification	Concentration
Methylene chloride		
CAS-No. 75-09-2 EC-No. 200-838-9 Index-No. 602-004-00-3	Skin Irrit. 2; Eye Irrit. 2; Carc. 2; STOT SE 3; STOT RE 2; H315, H319, H351, H336, H335, H373, H373	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Storage class (TRGS 510): Non-Combustible Liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use

in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Body Protection

Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engine protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	-97.0 °C
f) Initial boiling point and boiling range	40.0 °C at 1,013.2 hPa
g) Flash point	No data available
h) Evaporation rate	0.71
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 12 %(V)
k) Vapour pressure	470.9 hPa at 20.0 °C
l) Vapour density	2.93 - (Air = 1.0)
m) Relative density	1.32 g/cm ³
n) Water solubility	slightly soluble
o) Partition coefficient:	log Pow: 1.25

n-octanol/water

p) Auto-ignition temperature	556.1 °C
	662.0 °C
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

Relative vapour density	2.93 - (Air = 1.0)
-------------------------	--------------------

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Heat, flames and sparks. Exposure to sunlight.

10.5 Incompatible materials

Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - > 2,000 mg/kg (Methylene chloride)

LC50 Inhalation - Rat - 52,000 mg/m³ (Methylene chloride)

LD50 Dermal - Rat - > 2,000 mg/kg (Methylene chloride)

(OECD Test Guideline 402)

Skin corrosion/irritation

Skin – Rabbit (Methylene chloride)

Result: Irritating to skin. - 24 h

(Draize Test)

Serious eye damage/eye irritation

Eyes – Rabbit (Methylene chloride)

Result: Irritating to eyes. - 24 h

(Draize Test)

Respiratory or skin sensitisation

No data available (Methylene chloride)

Germ cell mutagenicity

(Methylene chloride)

Rat

DNA damage

Carcinogenicity

Limited evidence of carcinogenicity in animal studies (Methylene chloride)

Suspected human carcinogens (Methylene chloride)

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

No data available (Methylene chloride)

Specific target organ toxicity - single exposure

May cause respiratory irritation (Methylene chloride)

May cause drowsiness or dizziness (Methylene chloride)

Specific target organ toxicity – repeated exposure

Inhalation - May cause damage to organs through prolonged or repeated exposure. -

Central nervous system

Oral - May cause damage to organs through prolonged or repeated exposure. - Liver,

Blood

Aspiration hazard

No data available (Methylene chloride)

Additional Information

RTECS: Not available

Dichloromethane is metabolized in the body producing carbon monoxide which blood, reducing the oxygen-carrying capacity of the blood., Acts as a simple asphyxiant by displacing air., anesthetic effects, Difficulty in breathing, Headache, Dizziness, Prolonged or repeated contact with skin may cause:, defatting, Dermatitis, Contact with eyes can cause:, Redness, Blurred vision, Provokes tears., Effects due to ingestion may include:, Gastrointestinal discomfort, Central nervous system depression, Paresthesia., Drowsiness, Convulsions, Conjunctivitis., Pulmonary edema. Effects may be delayed., Irregular

breathing., Stomach/intestinal disorders, Nausea, Vomiting, Increased liver enzymes., Weakness, Heavy or prolonged skin exposure may result in the absorption of harmful amounts of material., Abdominal pain (Methylene chloride)

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated. (Methylene chloride)

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) 193.00 mg/l - 96 h (Methylene chloride)
	NOEC - Cyprinodon variegatus (sheepshead minnow) 130 mg/l – 96 h (Methylene chloride)
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) 1,682.00 mg/l - 48 h (Methylene chloride)

12.2 Persistence and degradability

Biodegradability	Result: < 26 % - Not readily biodegradable. (OECD Test Guideline 301C)
------------------	---

12.3 Bioaccumulative potential

Does not bioaccumulate.

12.4 Mobility in soil

No data available (Methylene chloride)

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID:	IMDG:	IATA:
----------	-------	-------

14.2 UN proper shipping name

ADR/RID:	IMDG:	IATA:
----------	-------	-------

ANNEX C Personal Protective Equipment for spraying foam

Protective clothing

- 1) Appropriate clothing to prevent chemical contact
- 2) Dispose the protective clothing after work to prevent the chemical exposure to the skin
- 3) Wear protective cloth to prevent chemical contact to skin

Respirators

Chemical aerosol of isocyanate in the air may exceed Occupational Exposure Limits for a sprayer and assistance working close to the equipment. Moreover, the aerosol of the catalyst (amine) and blowing agent can be found at high concentration. Indoor foam spraying generates more aerosol than outdoor foam spraying. Air supplied respirator is needed for indoor foam spraying; however, air purifying mask is safe enough for outdoor foam spraying.

Full-faced with air supplied respirator is needed for confined space.

Chemical protective clothing

Chemical protective clothing with a respirator is designed to protect worker from chemical exposure at normal working conditions.

Safety goggles

Goggles help prevent the chemical splash into the eyes and prevent the particulate from foam trimming. The PPE includes safety goggles, full-faced mask. Contact lenses are not recommend at work.

Gloves

Nitrile, Neoprene PVC gloves are safe enough to protect the skin from isocyanate and polyols. These types of gloves help protect workers' skin from chemicals and heat from tubing. Use the proper size of the gloves when spraying



Figure 8-1 chemical respirator



Figure 8-2 protective clothing



Figure 8-3 Safety goggles



Figure 8-3 Chemical gloves

ANNEX D Chemical management

Chemical management and storage

- Proper storage is important before and during foam spraying. Improper storage may affect the performance of the chemicals.
- Store polyol and isocyanate drum in cool and dry area following manufacturers' SDS. The chemical drum should be sealed to prevent the contamination.
- Prevent isocyanate drum from moisture or water. Water can react with isocyanate to generate carbon dioxide resulting in high pressure in a drum.
- Do not overlay isocyanate drums more than 3 layers, and prevent from heat and direct sunlight

first aid measures in case of chemical exposure

If inhale

- Stay away from aerosols of polyol and isocyanate all the time
- Evacuate from the area and see a doctor

If skin contact

- wash with soap and water to rinse off the skin, dispose the contaminated clothing
- In case of wound from high pressure of chemicals, see a doctor immediately

If eye contact

- Eye wash at least 10-15 minutes with plenty of warm water after that use eye patch and see a doctor immediately
- No contact lenses when spraying

If swallow

- Not recommend to vomit, see a doctor immediately

ANNEX E Environmental Management Plan: EMP

The enterprises, who want to join the HCFC phase-out program, need to prepare Environmental Management Plan and follow their existing standard operating procedure, which will be evaluated by the project management unit.

The enterprises may use/fill out the form below with the information and submit to the project management unit.

Suggestion

Please fill out the form and submit to the project management unit (PMU) including the general information i.e. map and technical information

During the program, the contact person should supervise and sign with date to confirm that the company will comply and follow all the rules and regulations. After sign, please submit the form to the project management unit

Environmental Management Plan for HCFC phase-out project

Part 1 Enterprise information

1.1 Business name..... Corporate registration number (if available) Website Product/Service Plant registration number (if available) Address Number..... Street address..... City..... Province..... Postcode..... Telephone..... Fax Contact person nameposition..... Telephone..... E-mail.....	
1.2 Business type	<input type="checkbox"/> Ordinary person <input type="checkbox"/> Ordinary Partnership <input type="checkbox"/> Limited partnership <input type="checkbox"/> Company limited <input type="checkbox"/> Other (Please specify)
1.3 General information	1. Type of the business <input type="checkbox"/> Spraying foam producer <input type="checkbox"/> Foam spraying 2. Business area <input type="checkbox"/> Residential area mixed with commercial area <input type="checkbox"/> Commercial area <input type="checkbox"/> Industrial area 3. Employee number (persons) <input type="checkbox"/> ≤ 5 <input type="checkbox"/> 6 - 30 <input type="checkbox"/> 31 – 50 <input type="checkbox"/> 51 – 200 <input type="checkbox"/> > 200 persons 4. Enterprise income <input type="checkbox"/> < 10 MB <input type="checkbox"/> 10 - 50 MB <input type="checkbox"/> 51 – 100 MB <input type="checkbox"/> > 100 MB
1.4 Blowing agent used	<input type="checkbox"/> HCFC-141b <input type="checkbox"/> HFO-1233zd <input type="checkbox"/> HFO-1336mzz-Z <input type="checkbox"/> Other (please identify)
1.6 Area type	<input type="checkbox"/> storage area (.....m ²) <input type="checkbox"/> Average area for spraying foam (.....m ² / time)
1.7 Maximum storage/time (kg)	<input type="checkbox"/> HCFC-141bkg <input type="checkbox"/> Pre-blend kg <input type="checkbox"/> MDI kg

Part 2 General information for spraying foam

2.1 General information for spraying foam						
Equipment information	Brand					
	Type (pressure)					
	Number					
2.2 Volume of HCFC-141b and pre-blend (kg)		2016		2017		2018
	HCFC-141b (100%)			HCFC-141b (100%)		HCFC-141b (100%)
	Pre-blend (.....% HCFC-141b)			Pre-blend (.....% HCFC-141b)		Pre-blend (.....% HCFC-141b)

Part 2 General information for spraying foam (continued)

2.3 Type of work	Risk type	Measure for risk control
Storage area	<input type="checkbox"/> Chemical spills	<input type="checkbox"/> Yes – Attachment 05 <input type="checkbox"/> No
	<input type="checkbox"/> Fire	<input type="checkbox"/> Yes – Attachment 05 <input type="checkbox"/> No
	<input type="checkbox"/> Chemical storage	<input type="checkbox"/> Yes – Attachment 06 <input type="checkbox"/> No
	<input type="checkbox"/> Other e.g. waste management, etc. (Please specify)	<input type="checkbox"/> Yes – Attachment 09 <input type="checkbox"/> No
Spraying foam area	<input type="checkbox"/> Chemical spills	<input type="checkbox"/> Yes – Attachment 05 <input type="checkbox"/> No
	<input type="checkbox"/> Work at Height	<input type="checkbox"/> Yes – Attachment 07 <input type="checkbox"/> No
	<input type="checkbox"/> Confined space	<input type="checkbox"/> Yes – Attachment 08 <input type="checkbox"/> No
	<input type="checkbox"/> Other e.g. waste management, etc. (Please specify)	<input type="checkbox"/> Yes – Attachment 09 <input type="checkbox"/> No

Part 3 Other

Attachment	
Business information - Role, responsibility, Time table for the progress and progress report (1 time before the program close)	Attachment 01
Map of the plant and surrounding (photo attachment)	Attachment 02
Map of storage area of HCFC-141b / Pre-blend / MDI (photo attachment)	Attachment 03
Standard Operating Procedure after HCFC phase-out - Checking equipment, pump, spray gun, tubing before and after use - Maintenance of equipment and PPE - Chemical safety training	Attachment 04
Safety measure after accident	Attachment 05
Safety measure for chemical storage	Attachment 06
Safety measure for work at height	Attachment 07
Safety measure for confined space	Attachment 08
Other safety or environmental management measure (if available)	Attachment 09

Note: If the form cannot be completed, please provide more relevant attachment

Signature _____

(_____)

Position* _____

* The manager or the person responsible for the sub-project operation

Attachment 01 General information of the business

Business name

Corporate registration number (if available)

Website Product/Service.....

Plant registration number (if available)

Address

 Number..... Street address.....

 City..... Province..... Postcode.....

 Telephone..... Fax

Contact person nameposition.....

 Telephone..... E-mail.....

Responsibility (See the details in 11.1)

1. Before conversion: (Please specify the details)

.....

.....

.....

2. After start of production: (Please specify the details)

.....

.....

.....

Time table for the progress

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

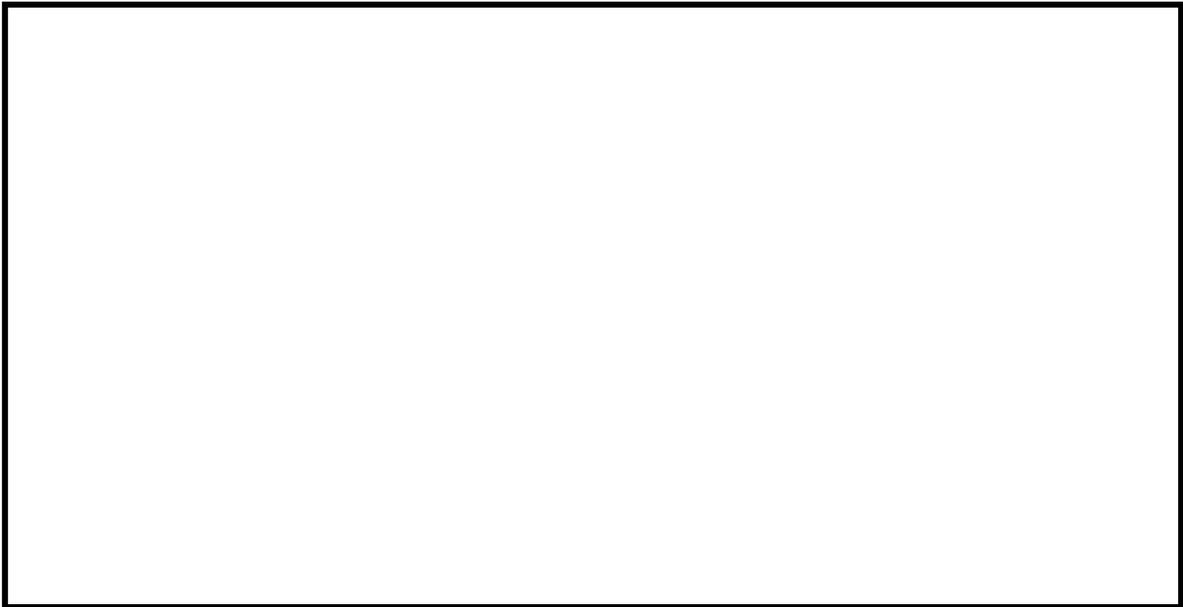
Progress report submission EMP (within 6 months after signed the contract)

dd/mm/yy.....

Attachment 02 Map of Enterprise location



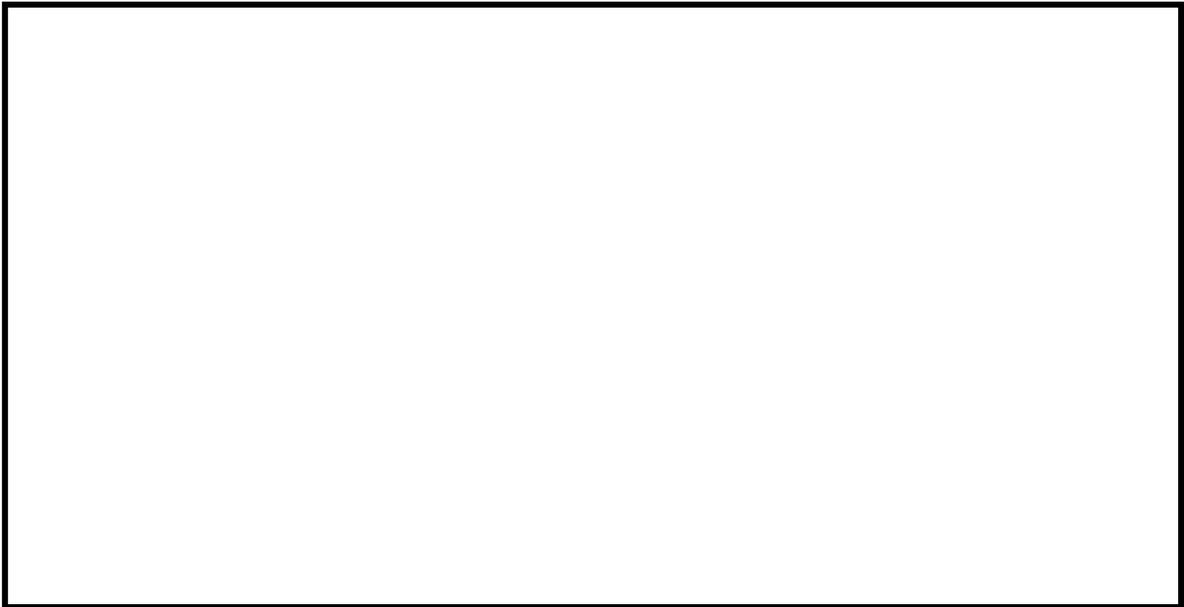
Map of Enterprise location (GPS)



Photos of Enterprise and surrounding areas (North)



Photos of Enterprise and surrounding areas (South)



Photos of Enterprise and surrounding areas (East)



Photos of Enterprise and surrounding areas (West)

Attachment 03 Map of chemical storage areas



Map of chemical storage areas

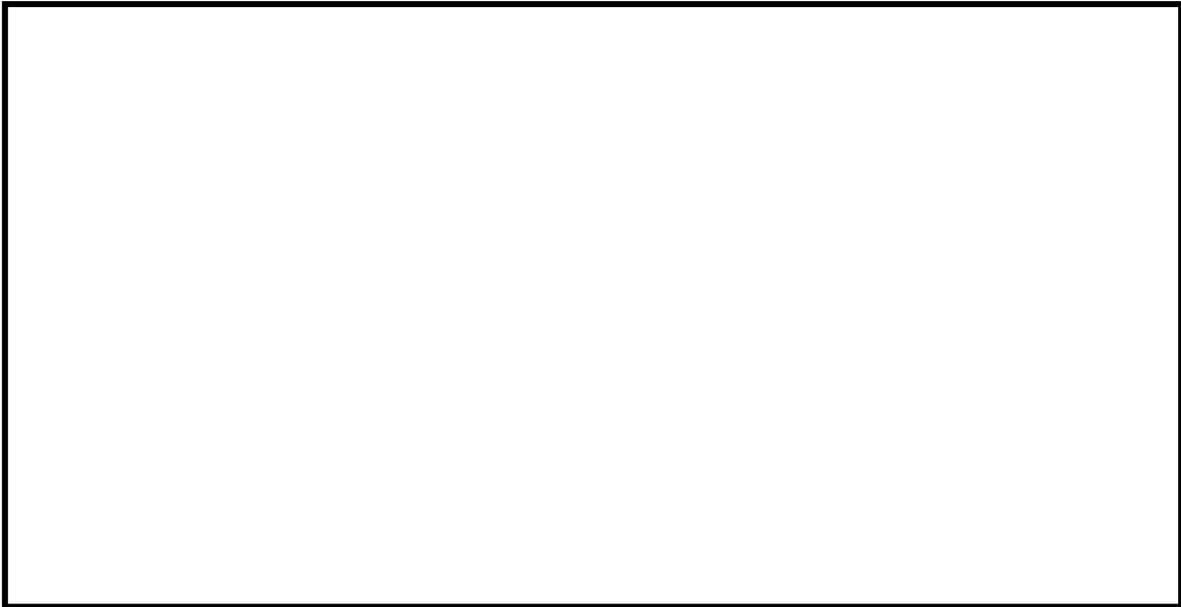


Figure 1 Photos of chemical storage areas



Figure 2 Photos of chemical storage areas

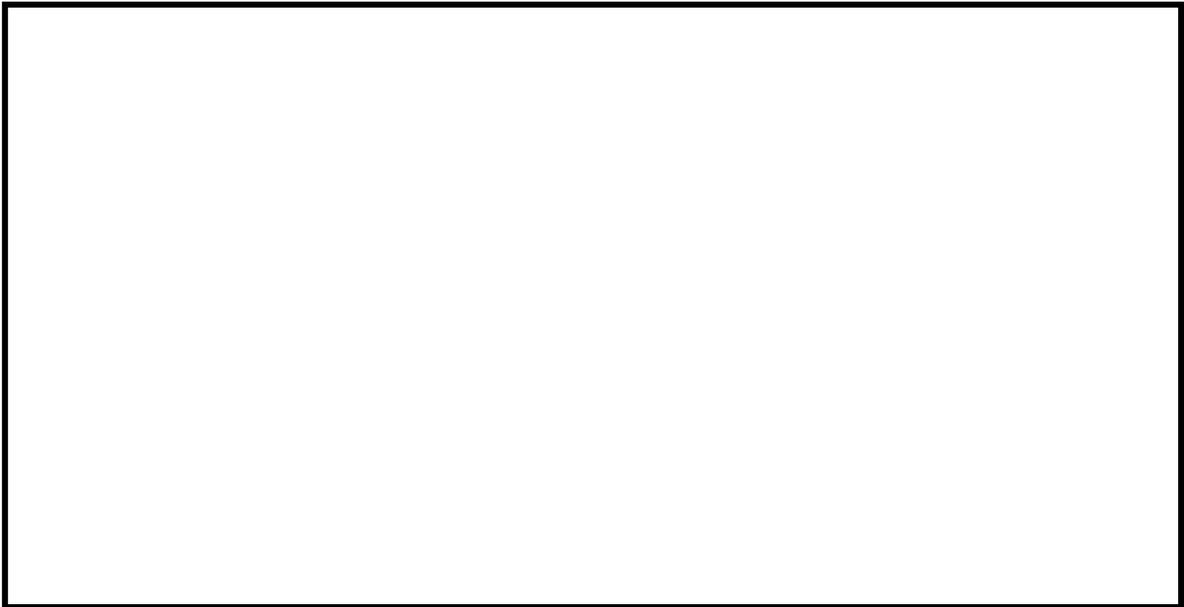


Figure 3 Photos of chemical storage areas

Attachment 04 Standard procedures for work after replacement of substitutes

Check list	Implementation ¹		Briefly describe suggestion/difficulty/action required) ²
	Yes	No	
1. Inspection of spraying equipment before and after use			
- Checking for leakage or damage of chemical pipes.			
- The condition of the air tank system is checked.			
- The condition of the electrical wiring of the equipment is checked.			
- With grounding or proper deposit.			
- Check the availability of foam spray guns.			
2. Provision and maintenance of equipment / PPE			
- There are maintenance tools according to the instruction manual.			
- PPEs are provided			
- Maintenance of PPE according to usage instructions			
3. Safety training in working with chemicals			
- There are chemical storage training.			
- There are chemical usage training.			
- There are training on the disposal of used chemicals.			

^{1,2} To be filled up during EMP Monitoring Period and submit to PMU and GSB within 6 months after sub-grant signing

Attachment 05 Emergency safety measures

If an emergency occurs during foam spraying, the operator should know that how to behave and must know who to contact to help limit damage and harm to workers and the environment. This section discusses how to proceed when an emergency, including people who have to deal with leakage management, to minimize environmental hazards, information about fire safety, and first aid.

1. Emergency contact number Contact information that employees should know is as follows.

1.1 Company owner number and employer number	
1.2 Urgency Alert Center	191
1.3 Fire center	199
1.4 Emergency illness notification center	1669
1.5 Department of Disaster Prevention and Mitigation Hotline	1784

2. When a chemical leak occurs

When large amounts of chemicals are spilled into the environment, contact the emergency numbers above.

If a small number of spills occur in the following actions.

- Evacuate those in the accident area from the area.
- When having to go to clean the scene, the worker must wear appropriate safety protection equipment
- Restricting the spread of chemicals such as dams or using absorbents etc.
- To scoop and collect the waste that occurred in the tank to be used to eliminate it properly.

3. When a fire occurs

To assess the severity of the fire incident. If the intensity is not large, bring a fire extinguisher type A B C and fire extinguishing foam to suppress fire.

If it is a severe case, evacuate the area as quickly and safely as possible and inform the fire center.

4. First aid

Should provide a first aid kit in the work area at all times.

Attachment 06 Chemical storage inspection form

Check list	Implementation ¹		Briefly describe suggestion/difficulty/action required) ²
	Yes	No	
1. Store all chemicals in a shade, not directly expose to sunlight and far away from heat			
2. Store the chemicals in dry area			
3. There is enough ventilation in the storage area.			
4. Inspect the leakage regularly for the chemical containers.			
5. Make safety data sheet (SDS) available and accessible all the time			
6. There is an emergency spill kit in the storage area.			

^{1,2} To be filled up during EMP Monitoring Period and submit to PMU and GSB within 6 months after sub-grant signing

Attachment 07 Work at height inspection form

Check list	Implementation ¹		Briefly describe suggestion/difficulty/action required) ²
	Yes	No	
1. Provide scaffolding, climbing stairs or safe trusses in the case of working in the ground or building floor from 1.80 meters or more.			
2. Create a barrier or fence in the event of working in an open floor or building and may fall.			
3. Establish rules for the use of scaffolding, ladder or trestle safely.			
4. There is enough space for work on scaffolding, ladder or trestle.			
5. The structure of scaffolding, ladder or trestle is strong and safe.			
6. Provide protection against splashes or dropping of materials by using a mesh, canvas or any other material that has the same characteristics, blocking or supporting.			

^{1,2} To be filled up during EMP Monitoring Period and submit to PMU and GSB within 6 months after sub-grant signing

Attachment 08 Safety measures for working in confined spaces

Check list	Implementation ¹		Briefly describe suggestion/difficulty/action required) ²
	Yes	No	
Work in confined spaces			
- Compliance with laws relating to working in confined spaces			
Working under the roof			
- The ceiling is opened or the roof is opened to increase ventilation.			
- With the use of ventilation fans.			
- There are periodic shuffle of operators.			

^{1,2} To be filled up during EMP Monitoring Period and submit to PMU and GSB within 6 months after sub-grant signing

ANNEX F Minutes of meeting, listening and commenting

Minutes of meeting, listening and commenting

“Environment Management Framework (EMF) Project for Spray Foam Sector”

Wednesday 19 June 2019 at 12.30 - 4.00 PM.

At Meeting Room 503, 5th Floor, Department of Industrial Works Building, Bangkok

Participants:

1. Rattana	Ruktrakul	Director of hazardous substances management division (Chair)
2. Naratip	Lauhatirananda	Acting expert scientist
3. Visitsak	Krissanapant	Specialized electrical engineer
4. Natawan	Sukchai	Specialized scientist
5. Jirodom	Turitakom	Specialized scientist
6. Khwanlak	Kanharat	Specialized scientist
7. Asst. Prof. Dr. Amarin	Kongtawelert	Mahidol University
8. Asst. Prof. Dr. Preecha	Loosereevanich	Mahidol University
9. Dr. Sumate	Pengpumkiat	Mahidol University
10. Saowarot	Phuaphonthep	Mahidol University
11. Rattanyu	Detchicharuwat	World Bank
12. Phongnarin	Phetchu	Chem-Safe Consultants Co. Ltd
13. Hattaya	Tiangtranont	Chem-Safe Consultants Co. Ltd
14. Akarin	Wangrit	Chem-Safe Consultants Co. Ltd
15. Nucharee	Jongsomboonphokha	S.P. Insulation Co. Ltd
16. Sawit	Injampa	S.P. Insulation Co. Ltd
17. Umphika	Surakitsamrit	Bangkok Insulate Co. Ltd
18. Somchat	Surakitsamrit	Bangkok Insulate Co. Ltd
19. Anuwat	Phatikkulrangsarn	Dabco Intertrade Co. Ltd
20. Wanlapa	Suteewon	Spec Engineering Co. Ltd
21. Hans	Lohr	Lohr Trade and Consulting Co. Ltd
22. Karl-Heinz	Martin Lohr	Lohr Trade and Consulting Co. Ltd
23. Woraphan	Techaworawat	South City Petrochem Co. Ltd
24. Prin	Phutisombut	South City Petrochem Co. Ltd (Chair of Polyurethanes Industry)
25. Sirinath	Wongpatham	Polyurethanes Industry
26. Jamnong	Khueankaew	New Tech and J Service Co. Ltd
27. Aphidach	Inthanai	New Tech and J Service Co. Ltd
28. Siriluk	Ngammee	Dow Chemical Thailand Co. Ltd

29. ChetChai	Norasetthisrisuk	PU Foam Insulation & Trading Co. Ltd
30. Punjama	Senaphithak	First Mega Tech Co. Ltd
31. Decha	Sriyong	First Mega Tech จำกัด
32. Athit	Somthawin	Bangkok Integrated Trading Co. Ltd
33. Thitinan	Phomphichan	Bangkok Integrated Trading Co. Ltd
34. Wirongrong	Phaosang	Balmoral Co. Ltd
35. Kiatchai	Atsawajitboon	Thai Mitsui Specialty Chemicals Co. Ltd
36. Yutthaphong	Kanokthanapa	Jebsen & Jessen Technology (T) Co. Ltd

Opening Time 01.30 PM.

The chairperson made an announcement to start the meeting/public hearing. The purposes of the meeting include;

1. To present the Environmental Management Framework (EMF) HCFC Phase-out project (replacement of HCFC-141b to HFO-1233zd, HFO-1336mz-Z and CO₂ in spray foam sector) to the public.
2. To obtain public hearing against the EMF and the EMP.

The consultant team (Asst. Prof. Dr. Amarin Kongtawelert) presented the Environmental Management Framework (EMF) HCFC Phase-out project. The main topics include;

- Rationale and objectives of the project
- Literature review for the chemical substitutes
- World Bank Safeguards Policies
- The objectives of the EMF
- Chemical process for polyurethane spray foam
- Schematic diagram of PU foam spraying unit with HFO
- Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) for several blowing agents
- Physical and chemical properties of blowing agents
- Environmental and OHS impacts
- Mitigation Measures
- Law and regulations regarding to the substitutes
- Field survey
- Personal Protective Equipment
- Chemical storage
- First aid
- Roles and responsibilities to implement EMF
- Institutional arrangement
- Grievance Mechanism

The consultant proposed the EMP and explained how to complete the plan and forms, examples of the plan, attachment forms and open the floor for public hearing.

Feedback voiced by the participants and stakeholder

1. Attachment No.04 should be grouped into categories, such as checklist for equipment, maintenance for equipment/PPE and training topics for chemical safety.

2. SOP for limited oxygen area should be classified into two types; confined space and area under the roof.

3. If workers need to spray PU foam in a confined space i.e. silo, they need to be trained in a course of “confined space” from their employers and the workers need to strictly comply with the law. In a case of the area under the roof, the workers have to open-up the roof or ceiling and use air ventilators. The workers also need to do work shift in every 20-30 minutes.

4. Most of the foam spraying is made under the roof. The aerosol foam can directly damage chemical cartridge respirator and safety goggles. In practical, the workers use clear plastic bag covering their head to prevent the mask and goggles from the adsorption of foam.

5. Chemical protective clothing, which is available in the market, is not practical suitable in Thailand due to the hot weather. Long-sleeve shirts and long pants with thin fabrics should be worn during working instead of thick protective clothing.

6. The participants and stakeholders called on World Bank to set rules and regulations for the enterprises to follow, and financially support for all relevant the trainings, PPE, oxygen meter, and supplied air respirators for confined space and area under the roof.

Closing Time 03:30 PM.



References

1. Environmental management framework. HCFC phase-out project polyurethane foam sector – stage 1
2. Carlos Mateu-Royo*, Joaquín Navarro-Esbrí, Adrián Mota-Babiloni, Marta Amat-Albuixech, and Francisco Molés. Thermodynamic analysis of low GWP alternatives to HFC-245fa in high-temperature heat pumps: HCFO-1224yd(Z), HCFO-1233zd(E) and HFO-1336mzz(Z). 2019; 152:762-77
3. Lists of enterprises from the World Bank
4. World Bank. (1999). Operational Manual OP 4.01 – Environmental Assessment. Available from: <https://policies.worldbank.org/sites/ppf3/PPFDocuments/090224b0822f7384.pdf>
5. International Finance Corporation. (2016). Environment, Health, and Safety Guidelines. Available from: <https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final+-+General+EHS+Guidelines.pdf?MOD=AJPERES>
6. Safety data sheet HFO-1233zd; Honeywell International Inc.
7. Safety data sheet HFO-1336mzz-Z; The Chemours (Thailand) Company Limited
8. Safety data sheet Polyol; Hilti (Gt. Britain) Ltd.
9. Safety data sheet Isocyanate; Sigma-Aldrich Pte Ltd
10. Safety data sheet Methylene chloride; Sigma-Aldrich Pte Ltd