



DEPARTMENT OF ENVIRONMENT, PARKS AND RECREATION
MINISTRY OF DEVELOPMENT
BRUNEI DARUSSALAM

GUIDELINE FOR SAFE HANDLING OF LOW-GWP (FLAMMABLE) REFRIGERANTS

FIRST EDITION (1st ed.)



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FOREWORD

In the year 1990 and 1993, Brunei Darussalam joined as a Party to the Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer respectively in order to reduce and eliminate Ozone Depleting Substances (ODS). Since then, the Government of Brunei Darussalam has showed its commitment towards the healing of the ozone layer to protect the well-beings of both nature and humanity alike. This includes implementing the national licensing system to control ODS imports and exports, providing trainings and capacity building to relevant government authorities, registered importers as well as refrigeration and air-conditioning (RAC) sector technicians and public awareness outreach in order to meet the objectives of these global environmental treaties. With all these activities being implemented, chlorofluorocarbons (CFCs) were successfully phased out by 2010 and the remaining ODS – Hydrochlorofluorocarbons (HCFCs) – are expected to be phased out by the year 2030.

However, while there is a significant success on the gradual healing of the ozone layer, there is still a substantial amount of work that needs to be done next – climate change. Hydrofluorocarbons (HFCs) were introduced as replacements to ODS for its desirable property as non-ODS, but they are powerful greenhouse gases with high Global Warming Potential (GWP) which can contribute to climate change.

With this reality in mind, the Kigali Amendment was adopted in 2016 to phase down HFC and other lower-GWP alternatives are introduced instead. A successful HFC phase-down is expected to avoid up to 0.4°C of global temperature rise by 2100, while continuing to protect the ozone layer. But these lower-GWP alternatives possess different characteristics that may restrict their usage such as flammability, toxicity and working pressures.

Considering the safety concerns that may implicate end-users, the Department of Environment, Parks and Recreation has developed this first edition of Guideline for Safe Handling of Low-GWP (Flammable) Refrigerants with joint collaboration across relevant government authorities and UNEP OzonAction Asia and Pacific Office in order to educate the public and relevant sectors on the proper procedures and requirements as well as to manage and mitigate associated safety risks.

We hope that this Guideline will be beneficial for everyone involved and it is one small measure that the public and relevant sectors can join in the global efforts of reducing the thinning of the ozone layer and bringing down the planet's global temperature. After all, success can be created and replicated in solidarity.

Martinah Binti Haji Tamit


Director
Department of Environment, Parks and Recreation
Ministry of Development

LIST OF CONTENTS

FOREWORD	2
LIST OF CONTENTS	3
LIST OF TABLES	5
LIST OF FIGURES	6
LIST OF ACRONYMS	8
LIST OF GLOSSARY	9
PREFACE	9
ACKNOWLEDGEMENTS	10
1 INTRODUCTION	
1.1 Background History	10
1.2 Information on Kigali Amendment	12
1.3 Objective of The Guideline	13
1.4 Institutional Framework	14
1.5 Classification and Flammability of Refrigerants	15
2 SAFE APPLICATION OF FLAMMABLE REFRIGERANTS	16
2.1 Understanding The Fire Triangle	16
2.2 Charge Limits of Refrigerant Based on Safety Classification	16
3 PERMIT LICENSING SYSTEM	17
3.1 Registration of Company to Import	17
3.1.1 For Supplying Activities Only	17
3.1.2 For (i) Servicing Activities Only Or (ii) For Both Supplying and Servicing Activities	19
3.2 Prior To Issuance of Permits	21
3.3 After Issuance of Permits	23
3.4 Recordkeeping of Documentations	24
4 SELLING AND PURCHASE OF REFRIGERANTS	25
4.1 Labelling of Cylinders	25
4.2 Selling of Refrigerants to Trained Technicians	25

LIST OF CONTENTS

5	INSTALLATION, SERVICE AND MAINTENANCE	27
5.1	Sources of Ignition	27
5.2	Temporary Flammable Zone	27
5.3	Pre-Service Safety	27
5.4	Good Servicing Practice Procedures	28
6	STORAGE	29
7	TRANSPORT	30
8	GENERAL REQUIREMENTS FOR USERS	31
9	REFERENCES	32
ANNEX I		33
ANNEX II		38
ANNEX III		38
ANNEX IV		38
ANNEX V		38

LIST OF TABLES

Table 1: Brunei Darussalam's ratification of the Montreal Protocol and its amendments	11
Table 2: ODPs and GWPs of common refrigerants	12
Table 3: Refrigerant classification and flammability based on ISO-817	15
Table 4: General requirements for users	31

LIST OF FIGURES

Figure 1: WhatGas? Application	15
Figure 2: Fire Triangle	16
Figure 3: Registration process of company to import for supplying activities only	18
Figure 4: Registration process for company to import for (i) servicing activities only or (ii) for both supplying and servicing activities	20
Figure 5: Process for applying permits	22
Figure 6: Process after declaring shipment	23
Figure 7: Refrigerant Identifier	25
Figure 8: Process for inspection and labelling of cylinders	26
Figure 9: Quick Guide on Good Servicing Practices for Flammable Refrigerants	28
Figure 10: Danger signage for storage area	29
Figure 11: Danger signage for transport vehicle	30

LIST OF ACRONYMS

ABCI	Authority for Building Control and Construction Industry
AC	Air-conditioner
AP	Application Permit
AIRAH	Australian Institute of Refrigeration, Air-Conditioning and Heating
BCM	Bromochloromethane
BDNSW	Brunei Darussalam National Single Window
CFC	Chlorofluorocarbon
CO₂	Carbon dioxide
DEPR	Department of Environment, Parks and Recreation
DME	Department of Mechanical and Electrical Services
FRD	Fire and Rescue Department
GWP	Global Warming Potential
HBFC	Hydrobromofluorocarbon
HC	Hydrocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HFO	Hydrofluoroolefin
HS Code	Harmonized Commodity Description and Coding System
HPMP	HCFC Phase-out Management Plan
ISO	International Organization for Standardization
iPIC	Informal Prior Informed Consent
LTD	Land Transport Department
LFL	Lower Flammability Limit
MLF	Multilateral Fund
MOD	Ministry of Development
MOFE	Ministry of Finance and Economy
MOHA	Ministry of Home Affairs

LIST OF ACRONYMS

MSDS	Material Safety Data Sheet
MTIC	Ministry of Transport and Infocommunications
NH₃	Ammonia
NOU	National Ozone Unit
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substance
PPE	Personal Protective Equipment
PWD	Public Works Department
R	Refrigerant
RI	Refrigerant Identifier
RAC	Refrigeration and Air-conditioning
RCED	Royal Customs and Excise Department
RMP	Refrigerant Management Plan
SOP	Standard of Procedures
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

LIST OF GLOSSARY

CHLOROFLUOROCARBON	A family of chemicals containing chlorine, fluorine and carbon.
GLOBAL WARMING POTENTIAL	The GWP compares the global warming impact of a gas to CO ₂ which is defined as having a GWP of 1.
HYDROCARBON	A family of chemicals containing hydrogen and carbon.
HYDROCHLOROFLUOROCARBON	A family of chemicals containing hydrogen, chlorine, fluorine and carbon.
HYDROFLUOROCARBON	A family of chemicals containing hydrogen, fluorine and carbon.
HYDROFLUOROOLEFIN	A family of chemicals containing hydrogen, fluorine and carbon, with a double bond in the molecule.
OZONE DEPLETING POTENTIAL	The ODP compares the impact on the ozone layer of a gas compared to CFC-11 which is defined as having an ODP of 1.
OZONE DEPLETING SUBSTANCE	A gas that can cause damage to the stratospheric ozone layer.
SPLIT SYSTEM	A type of refrigeration or air-conditioning system with a cooling evaporator in one location and a compressor/condenser in a different location. Usually used with reference to small air-conditioning systems that use an indoor unit and an outdoor unit.
STAND-ALONE SYSTEM	Small factory built refrigeration units that simply need to be connected to an electrical supply. A domestic refrigerator is a stand-alone system. Various types of stand-alone unit are used in food retail and food service.

PREFACE

The Guideline for Safe Handling of Low-GWP (Flammable) Refrigerants (herein, after referred to as “Guideline”) is aimed at managing the safety risks associated with handling of flammable refrigerants in the refrigeration and air-conditioning equipment and systems. It will serve as a companion to the existing international standards and to ensure consistency in obtaining approvals and requirements within Brunei Darussalam.

Additionally, this Guideline can be subjected to revisions according to the future standards stipulated by global market demands and policies.

ACKNOWLEDGEMENTS

The Department of Environment, Parks and Recreation acknowledges the assistance and contributions of the following and their representatives:

- Royal Customs and Excise Department, Ministry of Finance and Economy
- Fire and Rescue Department, Ministry of Home Affairs
- Department of Mechanical and Electrical Services, Public Works Department, Ministry of Development
- Authority for Building Control and Construction Industry, Ministry of Development
- Land Transport Department, Ministry of Transport and Infocommunications
- UNEP OzonAction Asia and the Pacific Office

1 INTRODUCTION

MONTREAL PROTOCOL

1.1 Background History

The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty designed to protect the earth's ozone layer by phasing out the consumption and production of a number of substances believed to be responsible for ozone depletion.

These substances are collectively named as

OZONE DEPLETING SUBSTANCES (ODS)

- 1 Halon
- 2 Chlorofluorocarbon (CFC)
- 3 Bromochloromethane (BCM)
- 4 Hydrochlorofluorocarbon (HCFC)
- 5 Hydrobromofluorocarbon (HBFC)
- 6 Methyl bromide
- 7 Methyl chloroform
- 8 Carbon tetrachloride





The treaty was opened for signature on 16th September 1987 and entered into force on 1st January 1989. To date, it is the only United Nations treaty that is universally ratified by 197 world countries.

Brunei Darussalam became a Party to the Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer on 26th July 1990 and 27th May 1993 respectively. Brunei Darussalam has also acceded to the subsequent London, Copenhagen, Montreal and Beijing Amendments on 3rd March 2009.

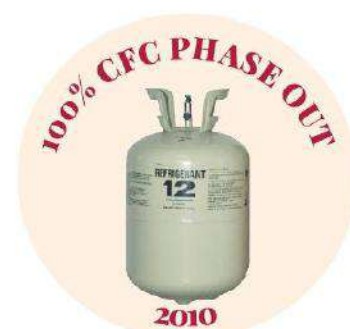
AGREEMENT	DATE OF RATIFICATION/ACCESSION/APPROVAL
Vienna Convention	26 th July 1990
Montreal Protocol	27 th May 1993
London Amendment	3 rd March 2009
Copenhagen Amendment	3 rd March 2009
Montreal Amendment	3 rd March 2009
Beijing Amendment	3 rd March 2009

TABLE 1

Brunei Darussalam's ratification of the Montreal Protocol and its amendments

To fulfil its obligations as a Party, the National Ozone Unit (NOU) under the Department of Environment, Parks and Recreation (DEPR), Ministry of Development is designated as the national focal point in which the Department is supported by United Nations Environment Programme (UNEP) as Lead Implementing Agency and United Nations Development Programme (UNDP) as Co-Implementing Agency.

With their support and assistance, Brunei Darussalam has implemented several measures and activities through projects funded by the Multilateral Fund (MLF). This includes policy development, institutional arrangements, capacity building and raising awareness. Some notable projects include Refrigerant Management Plan (RMP) which successfully 100% phased out CFCs in the year 2010.



Currently Brunei is progressing with the HCFC Phase-out Management plan (HPMP) to meet the 100% HCFC phase-out target by the year 2030.

1.2 Information on Kigali Amendment



With the phasing out of ODS, hydrofluorocarbons (HFCs) were introduced as alternatives for key end-user markets such as the refrigeration and air-conditioning (RAC) sector.

But while HFCs are non-ozone depleting substances, they are powerful greenhouse gases with high global warming potential (GWP) which can contribute to climate change (see Table 2). Therefore, every effort now needs to be made to use alternatives with a low climate impact.

On 15th October 2016, all Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer reached an agreement at the 28th Meeting of the Parties in Kigali, Rwanda to phase down the production and consumption of HFCs. This decision was adopted and is subsequently known as the Kigali Amendment. A successful HFC phase-down is expected to avoid up to 0.4 °C of global temperature rise by 2100, while continuing to protect the ozone layer.

ODPs and GWPs of common refrigerants			
Type	Gas	ODP	GWP (100 Year)
ODS	CFC - 11	1	4750
	HCFC - 22	0.055	1810
HFC	HFC - 404A	0	3922
	HFC - 410A	0	2088
	HFC - 134A	0	1430
	HFC - 32	0	675
HFO	HFO - 1234yf	0	4
Natural	HC - 290 (Propane)	0	3
	HC - 600 (Iso-butane)	0	3
	R - 744 (CO ₂)	0	1

TABLE 2

ODPs and GWPs of common refrigerants

1.3 Objective of the Guideline

The objectives of this Guideline are two-fold:



- 1 To manage the safety risks associated with handling of flammable refrigerants in the refrigeration and air-conditioning equipment and systems such as installation and servicing techniques.

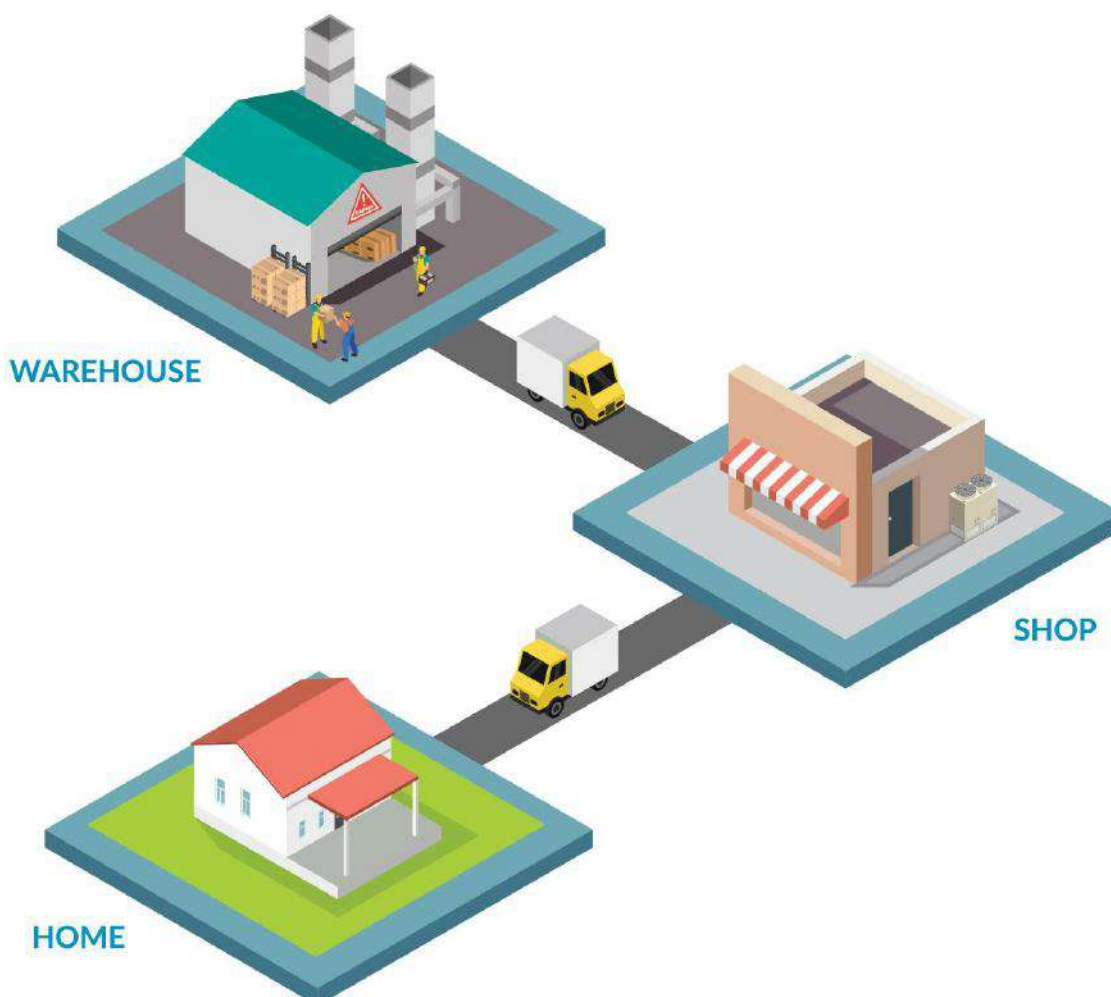


- 2 To ensure consistency in obtaining approvals and requirements from the relevant agencies within Brunei Darussalam.

Each agencies' roles are further detailed under Section 1.4: Institutional Framework.

As such, this Guideline is only applicable for refrigeration and air-conditioning equipment and systems which use lower GWP (flammable refrigerants) that are categorised as 2L, 2 and 3 refrigerants in accordance with ISO-817 of International Organization for Standardization (see Section 1.5).

This Guideline does not cover the use of ammonia (NH₃) and carbon dioxide (CO₂) refrigerants and its related systems.



1.4 Institutional Framework

The current institutional arrangements are the key main agencies that play an essential role in the development and implementation of the Guideline.

Department of Environment, Parks and Recreation (DEPR), Ministry of Development (MOD) is the national governing body for any matters relating to the environment and responsible for the planning, formulation and implementation of the Montreal Protocol including the establishment of regulations to support ODS phase-out activities. The DEPR not only plays a high-level role in promoting policies to push specific agendas to the Ministry of Development, it is also responsible for the reviewing and approval for any application by importers/exporters of ODS (mandatory) and ODS alternatives (voluntary) and subsequently issuing the Application Permits (APs).

Royal Customs and Excise Department (RCED), Ministry of Finance and Economy (MOFE) enforces Customs and Excise rules and regulations and played an important role for Brunei to achieve its Montreal Protocol obligations by regulating the import/export of ODS and ODS alternatives through the enforcement of the AP system.

Fire and Rescue Department (FRD), Ministry of Home Affairs (MOHA) is mandated to deal with matters pertaining to fire hazards and fire safety measures such as local transport and storage (Fire Certificate) which compliance to Fire Safety Order, 2016.

Department of Mechanical and Electrical Services (DME), Public Works Department (PWD), Ministry of Development (MOD) has the certification program for RAC technicians in place however it is intended only for RAC technicians working for the government project. Given that, DME plays a vital role in assessing technicians that have completed flammable training courses that have been recognized from authorized bodies.

Authority on Building Control and Construction Industry (ABCI), Ministry of Development (MOD) is a division under the Ministry of Development that is mandated as an authority to issue approvals for any building and construction work across all sectors. This also involves registration of products including RAC equipment upon endorsement by technical agencies. ABCi also published the Building Guidelines and Requirements and the Industrial Development Guideline which serve as a guideline aimed at promoting good quality building which are structurally safe to meet required health, environmental, fire, protection, sustainable buildings and other criteria.

Land Transport Department (LTD), Ministry of Transport and Infocommunications (MTIC) plays a role in ensuring the licensing, safety and worthiness of the vehicles used on the road, which includes registration of car servicing and repairing workshops as an Approved Workshops to comply with requirements and standards under LTD.

1.5 Classification and Flammability of Refrigerants

The table below (see Table 3) shows the most commonly used refrigerants in domestic refrigerators, stand-alone commercial refrigerators and room air-conditioners based on International Organization for Standardization (ISO) standard ISO-817.

CLASS	SAFETY GROUP	
HIGHER FLAMMABILITY 🔥🔥🔥	A3 i.e. HC-290, HC-600a	B3
FLAMMABILITY 🔥🔥	A2 i.e. R-152a	B2
LOWER FLAMMABILITY 🔥	A2L i.e. R-32, R-1234yf	B2L i.e. R-717 (ammonia)
NO FLAME PROPAGATION	A1 i.e. R-22, R134a R-410A, R-404A, R-407C, R-744	B1 i.e. R-123
	LOWER TOXICITY	HIGHER TOXICITY

TABLE 3

Refrigerant classification and flammability based on ISO-817

NOTE:

The letter A or B is assigned to indicate toxicity, while the number indicates the flammability.

Safety classification of refrigerant based on ISO-817 can be found from mobile application "What Gas?", which is available

- Online at www.unenvironment.org/ozonaction/resources/whatgas/whatgas or
- Download using the QR code below.

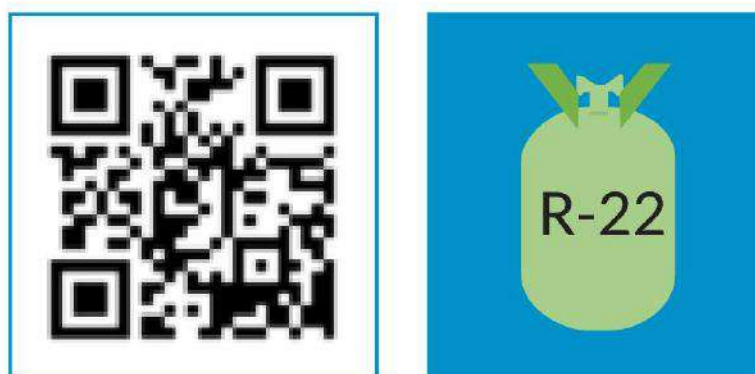


FIGURE 1

WhatGas? Application

2 SAFE APPLICATION OF FLAMMABLE REFRIGERANTS

2.1 Understanding the Fire Triangle

As seen in Figure 2, fire combustion will only occur if three conditions are met simultaneously in the appropriate proportions:

- 1 Heat
- 2 Fuel
- 3 Air (Oxygen)

Fire safety, as its most basic, is the principle of keeping fuel sources and ignition sources separate.

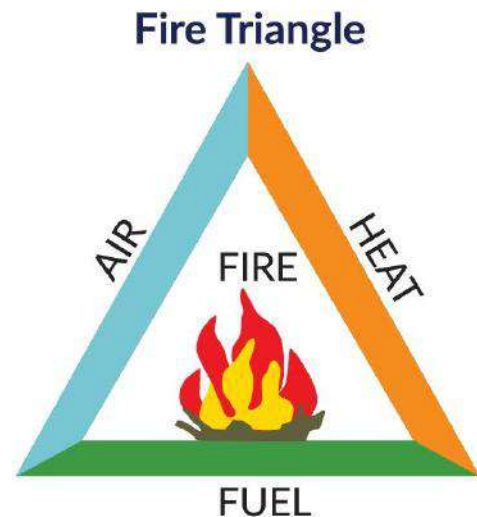


FIGURE 2
Fire Triangle
Source: AIRAH

2.2 Charge limits of Refrigerant based on Safety Classification

International standards have been adopted to limit the charge size of flammable refrigerants in refrigeration and air-conditioning equipment.

Any person who is handling installation and servicing of refrigeration and air-conditioning equipment containing refrigerant classified as 2L, 2 or 3 classification must ensure the followings are in accordance with provision set forth in "Annex I" of this Guideline:

- 1 Maximum allowable charge size of refrigerant in refrigeration and air-conditioning equipment being installed or serviced; and
- 2 Required minimum floor area of location of installation or serviced

③ PERMIT LICENSING SYSTEM



DEPARTMENT OF ENVIRONMENT, PARKS AND RECREATION
MINISTRY OF DEVELOPMENT
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As the designated licensing authority for ODS trade control in Brunei as well as its alternatives used in the RAC sector such as HFCs, DEPR is responsible for the registration of importers, allocation of annual quotas and approvals of the AP.

In 2014, RCED introduced an online declaration and permit application permit system which is an online platform accessible by DEPR, RCED and importers under the Brunei Darussalam National Single Window (BDNSW) to support facilitation of trade including the importation and exportation of ODS and its alternatives.

DEPR has set out a Standard of Procedures (SOP) for importers in order to obtain approval. Only importers who have an approved AP issued by DEPR is allowed to proceed with importation.

3.1 Registration of Company to Import

Companies who wish to import low-GWP (flammable) refrigerants under the Montreal Protocol are required to register as an importer under DEPR. The process for registration as an importer will depend on the company's intended business activities such as:

- For supplying activities only;
- For servicing activities only;
- For both supplying and servicing activities.

3.1.1 For Supplying Activities Only

- Companies who wish to carry out supplying activities only as the intended business activities must first apply for a Fire Certificate issued from the FRD (*see Section 6*).
- Each companies' forwarding agents are also required to apply for the Fire Certificate.
- Once the Fire Certificate is gathered, companies are required to fill in DEPR's registration form and submit both documents. DEPR's registration form can be downloaded online at DEPR website (www.env.gov.bn) or scan via QR code found in "Annex II" of this Guideline.
- The registration flowchart for supplying activities only can be found in *Figure 3*.

Get in touch with us!

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CHECKLIST OF REQUIRED DOCUMENTS:

- ☒ FRD Fire Certificate
- ☒ DEPR Registration Form

PROCESS FOR REGISTRATION OF COMPANY TO IMPORT

FOR SUPPLYING ACTIVITIES ONLY

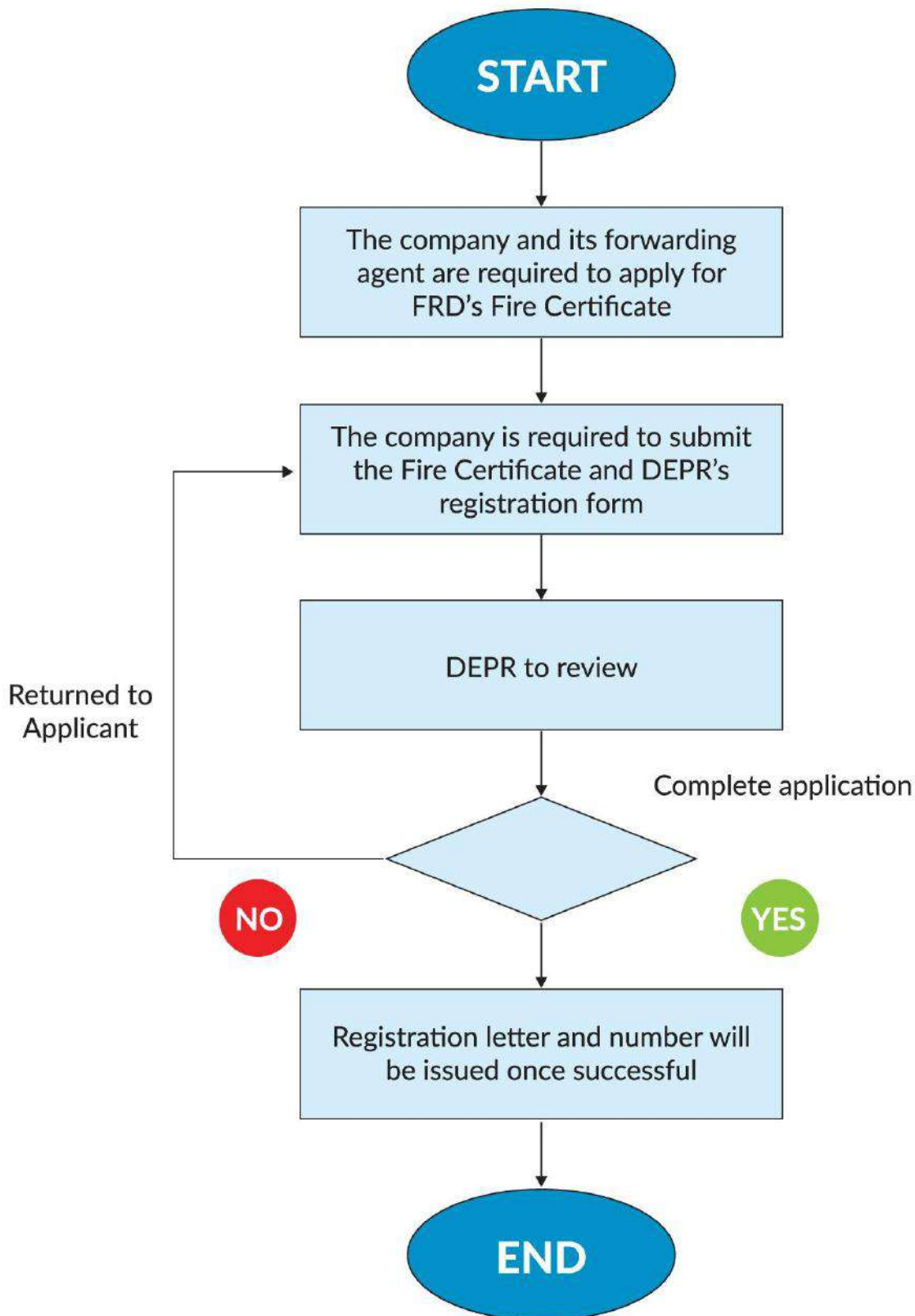


FIGURE 3

Registration process of company to import for supplying activities only

3.1.2 For (i) Servicing Activities Only or (ii) For Both Supplying and Servicing Activities

- Companies who wish to carry out (i) servicing activities only or (ii) both supplying and servicing activities as the intended business activities must first apply for a Fire Certificate issued from the FRD (*see Section 6*).
- Each companies' forwarding agents are also required to apply for the Fire Certificate.
- Companies are also required to provide an additional documentary evidence that at least one (1) of their technicians have completed a flammable training course from an authorized body recognized by DME.
- Once the necessary documents such as Fire Certificate and additional document that shows that at least one (1) technicians have completed a flammable training course are gathered, companies are required to fill in DEPR's registration form and submit those documents. DEPR's registration form can be downloaded online at DEPR website (www.env.gov.bn) or scan via QR code found in "Annex II" of this Guideline.
- The registration flowchart for (i) servicing activities only or (ii) for both supplying and servicing activities can be found in *Figure 4*.



CHECKLIST OF REQUIRED DOCUMENTS:

- ☒ FRD Fire Certificate
- ☒ DEPR Registration Form
- ☒ Documentary evidence that at least one (1) technicians have completed a flammable training course from an authorized body recognized by DME

PROCESS FOR REGISTRATION OF COMPANY TO IMPORT

FOR (i) SERVICING ACTIVITIES ONLY OR (ii) FOR BOTH SUPPLYING AND SERVICING ACTIVITIES

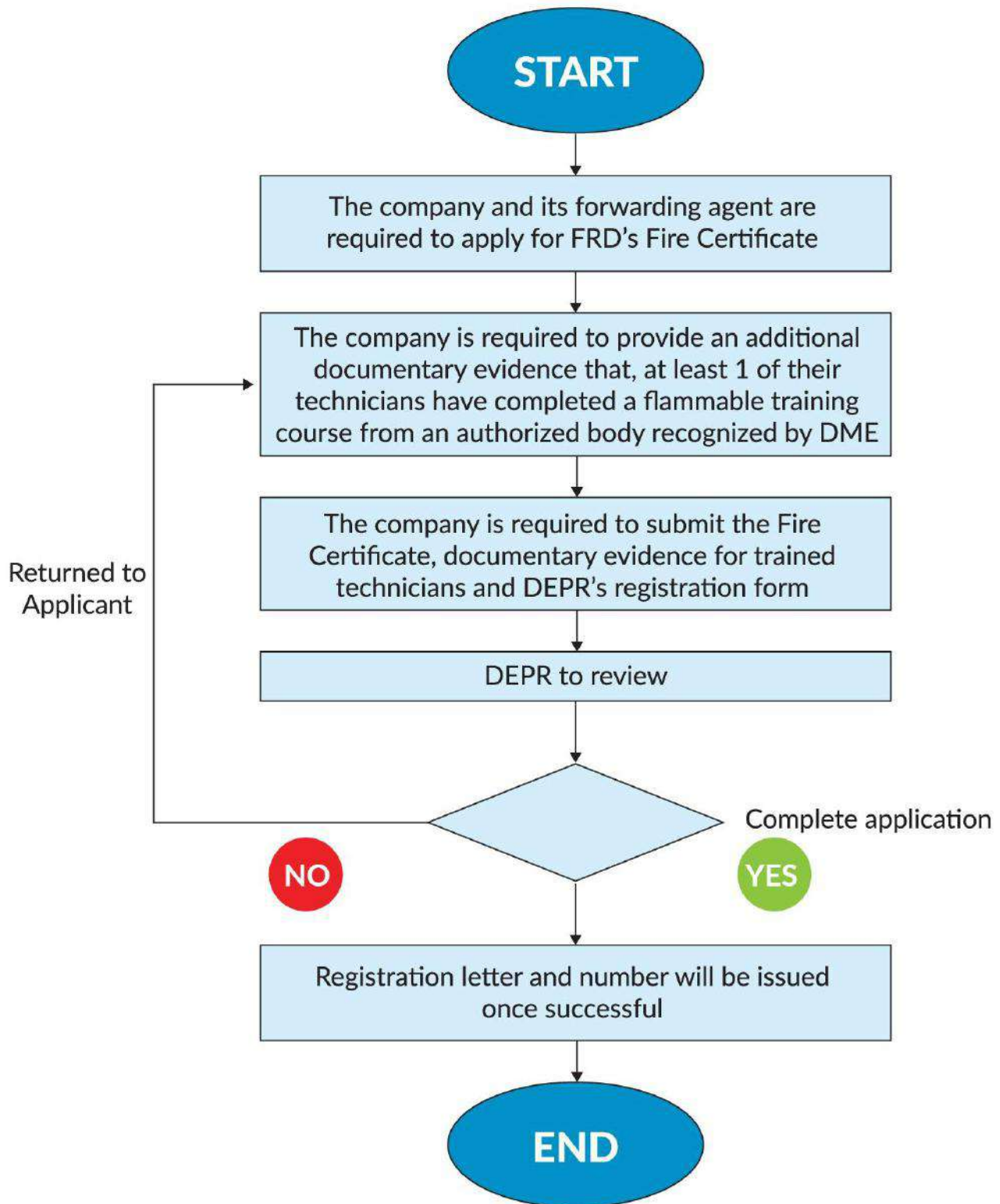


FIGURE 4

Registration process of company to import for (i) servicing activities only or (ii) for both supplying and servicing activities

3.2 Prior to Issuance of Permits

- Registered importer and exporter must be responsible in ensuring that the flammable refrigerants imported or exported are consumed appropriately by adhering to the Material Safety Data Sheet (MSDS) of each specified refrigerant.
- Prior to each shipment, a registered importer and exporter are required to submit the Pre-Application Form which can be found in “Annex III” of this Guideline.
- Importers and exporters are also required to submit the Invoice or Purchase Order, MSDS and any other relevant documents.
- DEPR will conduct the Informal Prior Informed Consent (iPIC) and bilateral communication with relevant authorities of the importing or exporting countries, to reconfirm on the registration of the importing or exporting companies if applicable.
- Once the confirmation has been received, importers and exporters can apply for the Permit from DEPR through the permit application system called the BDNSW which is administered by the RCED.
- The permit would be issued by DEPR once it determines that the following conditions are fulfilled:
 - Importers and exporters are required to attach the Invoice or Purchase Order, MSDS and any other relevant documents,
 - Importers and exporters are required to fill in the correct information through the BDNSW such as:
 - ① Harmonized System (HS) code;
 - ② Description of refrigerant;
 - ③ Quantity of cylinders;
 - ④ Total weight of cylinders (in kg);
 - ⑤ Country of export;
 - ⑥ Name of exporting company;
 - ⑦ Name of forwarding agent (if any); and
 - ⑧ Any other relevant information.
 - Once the abovementioned requirements have been fulfilled, the permit would be issued to the local importers and exporters.
 - The expiration date of the permit is either three (3) months after issuance or 31 December of the year the permit is issued, whichever occurs first.

PROCESS FOR APPLYING PERMITS

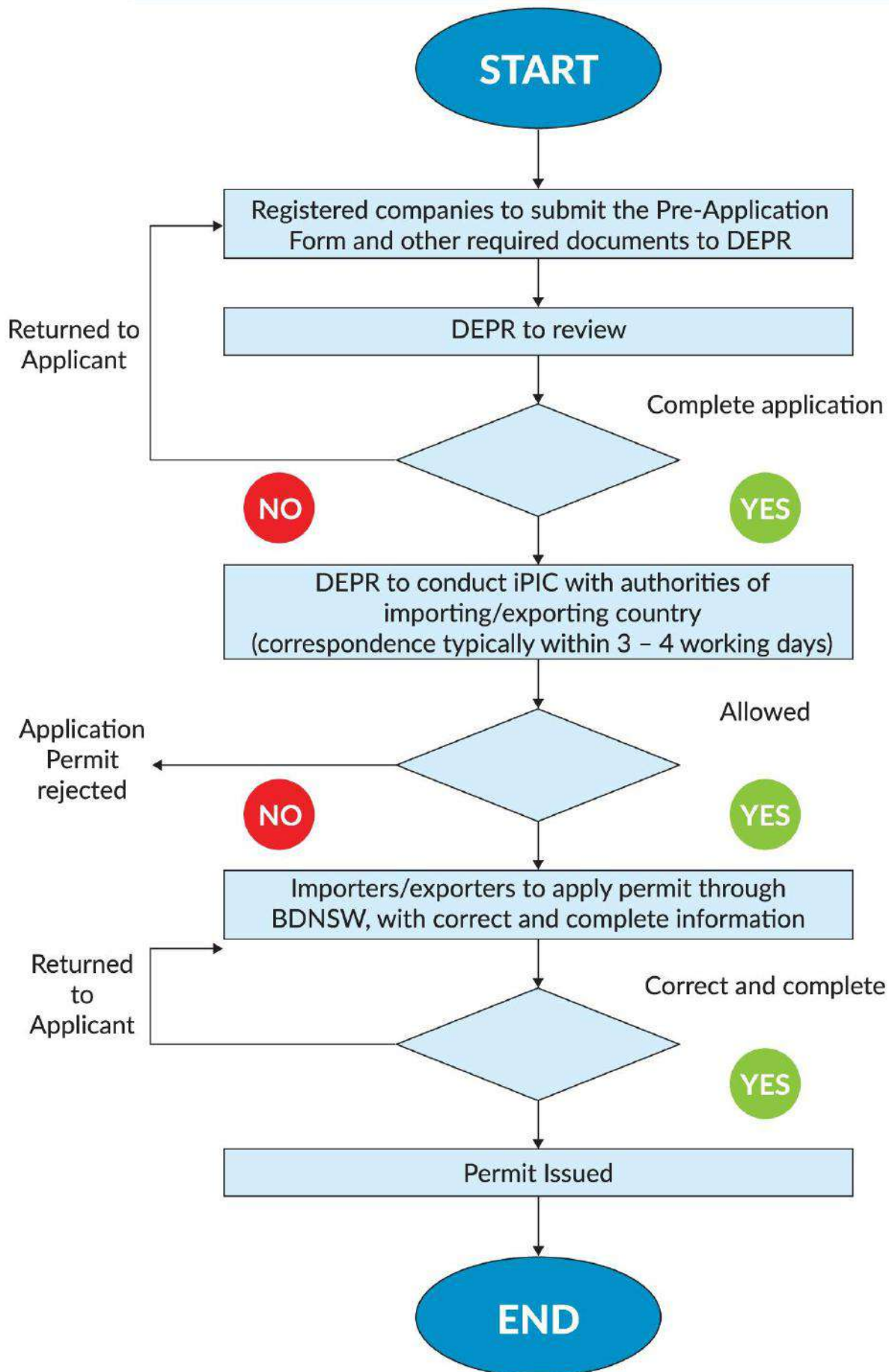


FIGURE 5

Process for applying permits

3.3 After Issuance of Permits

- Once the permit is given to the importers or exporters, they are required to show the permit and other relevant documents to the RCED before the shipment can be cleared.
- Importers or exporters are required to submit the following documents not more than seven (7) working days to DEPR after the shipment has been declared:
 - Delivery Order or Air Waybill
 - Packing List
 - Customs Declaration Form from RCED
 - Certificate of Analysis from RCED (if applicable)
- All importers are required to submit the following documents based on their previous permits to DEPR for every new application of import permit:
 - Summary of Importing and Reporting Information; and
 - Summary of Distribution
- All importers are required to submit the following documents based on their previous permits to DEPR for every new application of import permit:

CHECKLIST OF REQUIRED DOCUMENTS AFTER DECLARATION PROCESS:

- ☒ Delivery Order or Air Waybill
- ☒ Packing List
- ☒ Customs Declaration Form from RCED
- ☒ Certificate of Analysis from RCED (if applicable)
- ☒ Summary of Importing and Reporting Information
- ☒ Summary of Distribution

PROCESS AFTER DECLARING SHIPMENT

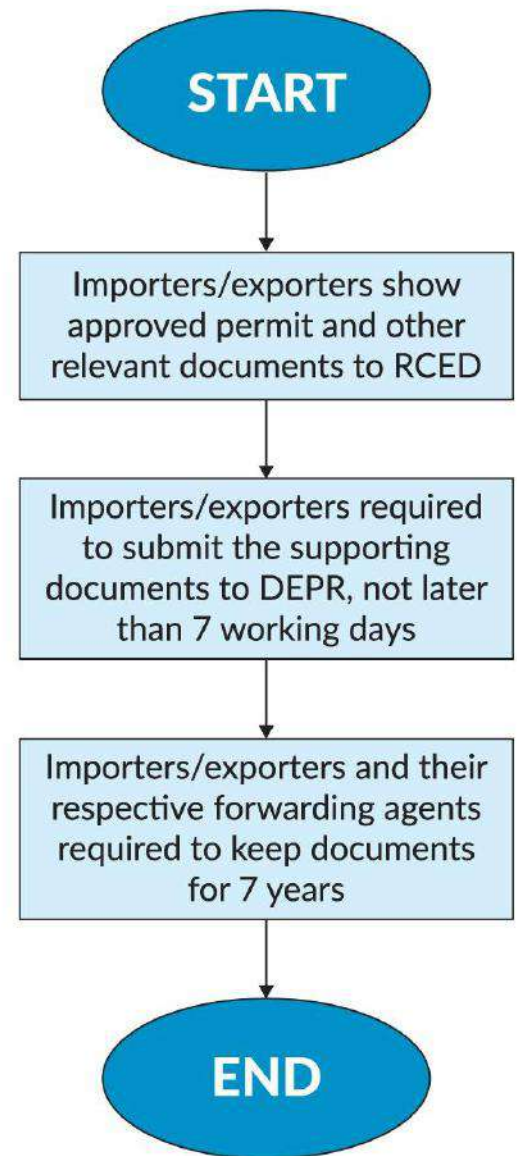


FIGURE 6

Process after declaring shipment

3.4 Recordkeeping of Documentations

Importers, exporters and their respective forwarding agents are required to keep the previously mentioned documents for a period of seven (7) years for auditing purposes.



CHECKLIST OF DOCUMENTS TO KEEP:

- | | |
|---|---|
| ☒ FRD Fire Certificate | ☒ Delivery Order / Air Waybill |
| ☒ DEPR Registration Form | ☒ Packing List |
| ☒ Documentary evidence that at least one (1) technicians have completed a flammable training course from an authorized body recognized by DME | ☒ Customs Declaration Form from RCED |
| ☒ Pre-Application Form | ☒ Certificate of Analysis from RCED (if applicable) |
| ☒ Invoice / Purchase Order | ☒ Summary of Importing and Reporting Information |
| ☒ Material Safety Data (MSDS) Sheet | ☒ Summary of Distribution |

A Reminder for:

IMPORTERS, EXPORTERS AND FORWARDING AGENTS

Should any of the above mentioned requirements in this section is not fulfilled, DEPR has the authority to revoke the permit for a period of three (3) months.

Any permit applications from importers or exporters will not be verified and approved by DEPR.



Important Reminder

Did I complete all the requirements here?

Yes!

4 SELLING AND PURCHASE OF REFRIGERANTS

4.1 Labelling of Cylinders

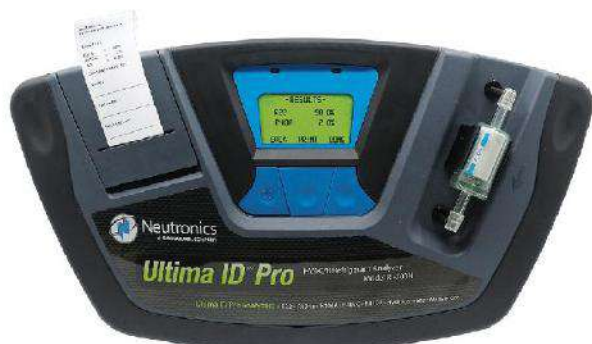


FIGURE 7
Refrigerant Identifier

Labeling of cylinder is only applicable to refrigerant that could be detected by refrigerant identifier available at the authority. Before the cylinders are distributed to the market, importers are required to inform and submit the Details of Shipment Form to DEPR for inspection. The form can be downloaded online at DEPR website (www.env.gov.bn) or scan via QR code found in "Annex V" of this Guideline.

Once the inspection has passed, DEPR will issue stickers for labelling. Any refrigerant cylinder found in the local market without stickers will be investigated and can be seized by the relevant authority.

4.2 Selling of Refrigerants to Trained Technicians

Before selling the flammable refrigerants, all importers/traders are required to ensure that:

- 1 Companies who wish to purchase should have at least one (1) technician who have completed a flammable training course from an authorized body recognized by DME and/or;
- 2 Individual who wish to purchase should have completed a flammable training course from an authorized body recognized by DME.

All importers are required to keep an inventory list of usage and sales and submit the documents to DEPR for every new application of import permit. The documents which are (i) Summary of Importing and Reporting Information and (ii) Summary of Distribution which can be downloaded online at DEPR website (www.env.gov.bn) or scan via QR code found "Annex IV" of this Guideline.



FIND A LIST OF TRAINED TECHNICIANS ONLINE AT DEPR WEBSITE!

This is to ensure:

- ☒ Proper handling and efficient servicing of equipment using lower GWP (flammable) refrigerants.
- ☒ Safety of servicing technicians and consumers using the equipment.

PROCESS FOR INSPECTION AND LABELLING OF CYLINDERS

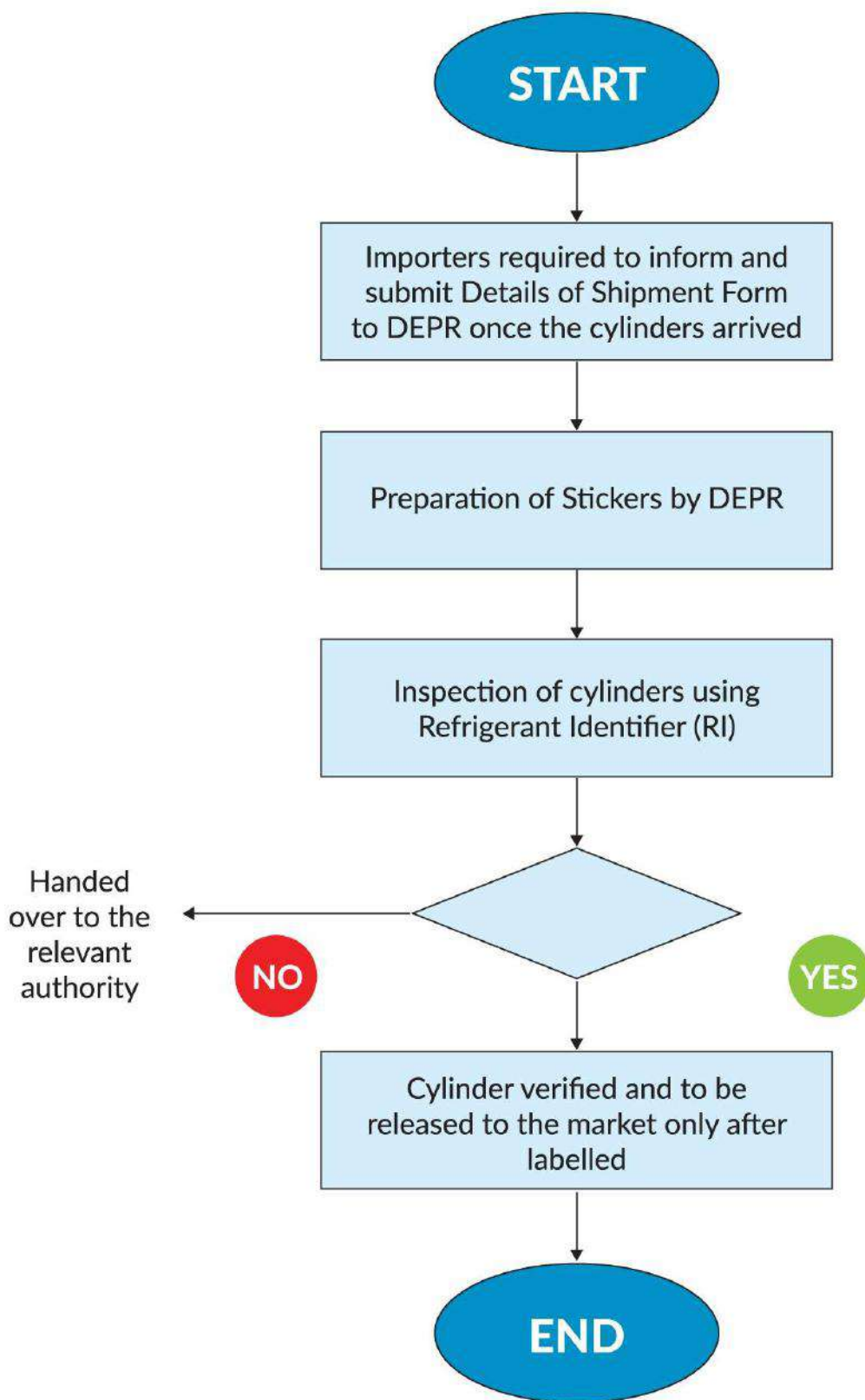


FIGURE 8

Process for inspection and labelling of cylinders

5 INSTALLATION, SERVICE AND MAINTENANCE

5.1 Sources of Ignition

No flammable materials and ignition sources should be present near the flammable refrigerants and equipment using these flammable refrigerants.

Potential sources of ignition may include but not limited to:

- Hot Surface
- A naked or open flame
- A spark from an electrical source
- Lightning
- Areas with gas cooktops and gas water heaters
- Electrical sockets, power outlets, lights and switches, electric motors

5.2 Temporary Flammable Zone

When working on systems using flammable refrigerants, technicians should always consider working areas as “temporary flammable zones”.

A “temporary flammable zone” is a minimum of 2 meters from the point in all directions for small appliances. For larger systems, a greater distance should be allowed.



5.3 Pre-Service Safety

The following precautions should be taken before undertaking servicing, maintenance and repair of the system:

- Identify the refrigerant in the system being serviced. If identification is not possible, treat it as a class 3 refrigerant.
- No flammable materials and no ignition sources should be present in the work area.
- Ensure suitable fire extinguishing equipment (CO₂ or dry-powder type) is available and functioning.
- Section off area around the workspace and erect appropriate signage e.g. “No smoking”, “Do not enter the area”, “Work in Progress”.
- Ensure the work area is properly ventilated and that any released refrigerants can be safely dispersed to the outside.
- Ensure suitable gas detectors are present and operating.
- Wear Personal Protective Equipment (PPE) or safety gear.
- Working within restrictive spaces should be avoided. When this cannot be avoided, additional safe working practices should be employed including working with a buddy and appropriate PPE.

5.4 Good Servicing Practice Procedures

Please refer to Section 4.5 of the Good Servicing Practices for Flammable Refrigerants: A Quick Guide for more reference.

An electronic version of the “Quick Guide on Good Servicing Practices for Flammable Refrigerant” is available for free download on the Google Play Store and Apple App Store below.

All persons involved in the servicing and/or maintenance of the equipment must ensure that the gases are to be used up completely to avoid any gas remains inside the cylinder prior to using a new cylinder.

Quick Guide on Good Servicing practices for Flammable Refrigerants



NEEDS ATTENTION

- ☒ Equipment designed for non-flammable refrigerants e.g. HCFC-22 or R-410A etc. are not designed to be used with flammable refrigerant.
- ☒ Do not retrofit any non-flammable refrigerant system to use with any flammable refrigerants.
- ☒ Do not drop-in flammable refrigerant into non-flammable refrigerant system.



FIGURE 9

Quick Guide on Good Servicing Practices for Flammable Refrigerants

6 STORAGE

Storage buildings are required to obtain a Fire Certificate issued by FRD. It ensures all fire safety requirements have been met and are in accordance with Fire Safety Order, 2016 and the Building Requirements and Guidelines (4th Edition: 2017).

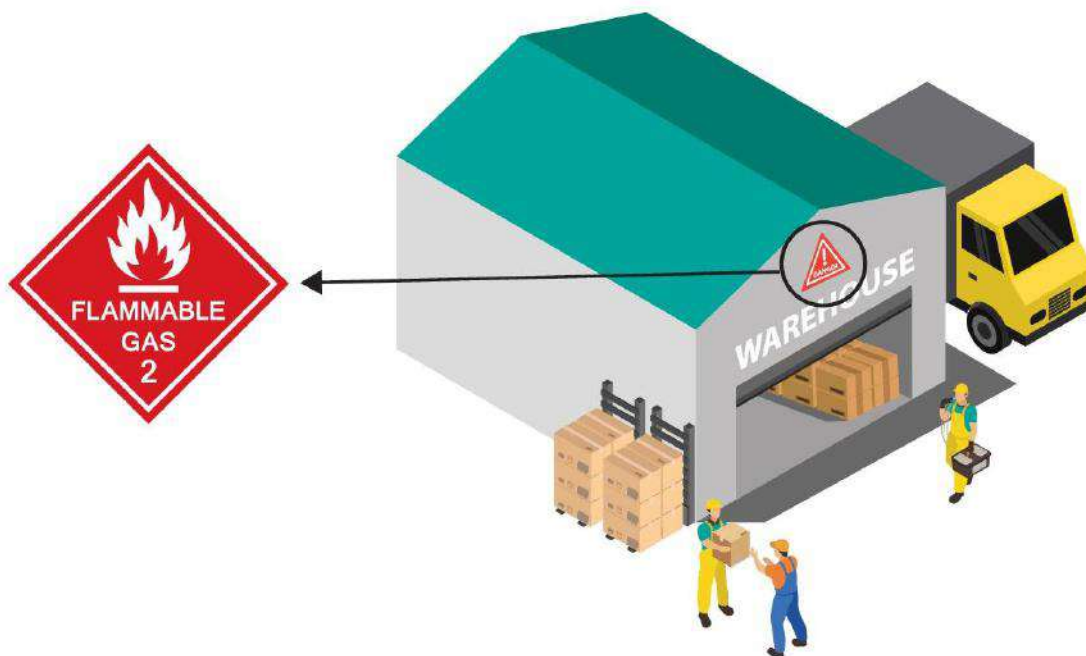


FIGURE 10

Danger signage for storage area

The following general requirements and precautionary measures must be fulfilled:

- The storage area must be well-ventilated.
- The storage area must be free of combustible or waste materials.
- The storage area must display danger signage as illustrated in Figure 10.
- The cylinders must be stored on the ground floor, but not in basements and other enclosed rooms.
- The cylinders must be kept separate from non-flammable, oxygen and toxic gas.
- The cylinders must not be lying on their side and should be protected from falling or being knocked over.
- The cylinders must be secured from being tampered or theft.
- The cylinders must be kept away from sources of heat and direct sun.
- The cylinders must be kept at least 3 meters away from any potential ignition sources.

For more details and information in this Section, please kindly refer to Fire and Rescue Department for clarification.

7 TRANSPORT

Prior to transportation, FRD must be notified to ensure the nearest operation branch will be on standby for any unforeseen situations.



FIGURE 11

Danger signage for transport vehicle

The following general requirements and precautionary measures must be fulfilled:

- The main cylinder valve must be shut-off and any regulator removed prior to loading.
- The cylinders must be stored upright (vertical) position and restrained to ensure they cannot move during transport.
- The transport vehicle must display danger signage as illustrated in Figure 11.
- It is preferable to use an open air truck but in case of an enclosed truck, please ensure proper ventilation during transportation.
- The cylinders must be kept away from any potential ignition sources.
- The transport vehicle must be fitted with a fire extinguisher.
- Drivers should be aware of the associated risks and should be trained on the use of fire-fighting equipment.

Get in touch with Fire and Rescue Department!

ADDRESS:

Ibu Pejabat Jabatan Bomba dan Penyelamat,
Kementerian Hal Ehwal Dalam Negeri,
Landasan Lama Berakas,
Bandar Seri Begawan, BB3510,
Negara Brunei Darussalam

CONTACT NUMBER:

(+673) 2380409

For more details and information in this Section, please kindly refer to Fire and Rescue Department for clarification.

8 GENERAL REQUIREMENTS FOR USERS

For customers or users of flammable refrigerant-based equipment, the following general requirements and precautionary measures must be fulfilled:



DO

Ensure to engage with only companies registered under DEPR for purchase of flammable refrigerants and/or servicing of equipment.

Ensure the technicians servicing the flammable refrigerants equipment are trained professionally.

A list of trained technicians can be found online on DEPR website (see www.env.gov.bn).

Turn off equipment switch when the room is not in use.

If any abnormalities (e.g. excessive noise, vibration, abnormal smell) are detected, stop the unit and arrange for repair.

DON'T

Do not connect other electrical appliances to the same socket outlet as flammable refrigerants equipment.

Do not allow technician to drop-in or top-up a system using one refrigerant with another different type, especially flammable refrigerants.

Equipment designed for non-flammable refrigerants e.g. HCFC-22 or R-410A etc. are not designed to be used with flammable refrigerant. Therefore, do not allow technician to retrofit any system to use any flammable refrigerants.

TABLE 4

General requirements for users

9 REFERENCES

- The Australian Institute of Refrigeration, Air-Conditioning and Heating (AIRAH), Flammable Refrigerants – Safety Guide, ISBN: 978-0-949436-05-4, 2013 (available online at https://www.airah.org.au/Content_Files/FRSG/Flammable-Refrigerant-Safety-Guide-2013.pdf?pdf=Flammable-Refrigerants-2013)
- United Nations Environment Programme, Good Servicing Practices for Flammable Refrigerants: A Quick Guide, 2016

Annex I

A-1: Charge Limitation of Flammable Refrigerant in Room Air-conditioners used for 'Human Comfort'

To prevent fire hazards from the use of flammable refrigerant, relevant standards have been adopted to limit the charge size of flammable refrigerant in RAC equipment. In principle, the following factors must be considered to determine charge limits of flammable refrigerants in a RAC system:

- Flammability group of the refrigerant: For example, R-32 (Group 2L) and R-290 (Group 3) have different flammability properties which affect the charge limits in the RAC system.
- Occupancy classification: This factor indicates the level of restriction that people can access in the rooms and parts of buildings in which a RAC system is installed. These are classified into general occupancy, supervised occupancy and authorized occupancy.
- Location classification of RAC equipment: Charge limitation also depends on the location of the refrigerant-containing parts, e.g. whether it is located in an occupied space, a machinery room (enclosed room or space with mechanical ventilation), in the open air or in a ventilated enclosure.

A-2: Formula for Calculation

To determine the maximum allowable charge size, a RAC servicing technician should be properly trained to comply with the manufacturer's operational manual for the specific RAC equipment being installed/serviced, as well as the relevant national standards.

In cases where national standards do not exist, the formula in Table 4 can be useful for RAC servicing technicians to determine the charge limits of R-32 (Group 2L) and R-290 (Group 3) in unitary and split-type air-conditioners installed for 'human comfort' in rooms/parts of buildings classified as "General Occupancy." The maximum allowable charge size calculated in this guide book is based on the formula specified in the ISO 5149-1:2014 standard.

To calculate charge limit requirements of RAC systems which are:

- Not unitary and split-type air-conditioners,
- Not installed for 'human comfort' in the general occupancy category,

>> please refer to relevant requirements indicated in the ISO 5149-1:2014 standard.

Charge limitation is the standard maximum allowable charge size of refrigerant in the respective occupancy type and location in which the RAC equipment can be safely used. It is not the actual charge size of refrigerant in the system.

¹General occupancy is rooms, parts of a building where people can sleep, people are restricted in their movement or the uncontrolled number of people is present without being personally acquainted with the necessary safety precautions.

A-2.1: Formula for Calculation of Charge Limits

Refrigerant Group	Formulation
Flammability class 2L e.g. R-32	$m_{\max} = 2.5 \times \text{LFL}^{1.25} \times h_0 \times A^{0.5}$ but not more than 39 x LFL
Flammability class 2 and class 3 e.g. R-290	$m_{\max} = 2.5 \times \text{LFL}^{1.25} \times h_0 \times A^{0.5}$ but not more than 26 x LFL

Where:

$m_{\max}$ = Maximum allowable charge in a room in kg

A = Room area in m²

LFL = Lower Flammability Limit in kg/m³

h_0 = Height factor in m, based upon the method of mounting the appliance

- o 0.6 metres for floor location
- o 1.0 metres for window mounted
- o 1.8 metres for wall mounted
- o 2.2 metres for ceiling mounted

LFL of R-32 is
0.307 kg/m³

LFL of R-290 is
0.038 kg/m³

Example for calculation

A RAC servicing technician would like to install an R-32 wall mounted air-conditioner in a 30 m² room.

$$\begin{aligned}
 m_{\max} &= 2.5 \times \text{LFL}^{1.25} \times h_0 \times A^{0.5} \\
 &= 2.5 \times 0.307^{1.25} \times 1.8 \times 30^{0.5} \\
 &= 5.63 \text{ kg}
 \end{aligned}$$

Check whether the calculated amount is more than 39 x LFL = 39 x 0.307 = 11.97 kg. In this case, the $m_{\max}$ is less than 11.97 kg. Therefore, 5.63 kg is the maximum allowable charge size.

A RAC servicing technician would like to install an R-290 wall mounted air-conditioner in a 30 m² room.

$$\begin{aligned}
 m_{\max} &= 2.5 \times \text{LFL}^{1.25} \times h_0 \times A^{0.5} \\
 &= 2.5 \times 0.038^{1.25} \times 1.8 \times 30^{0.5} \\
 &= 0.41 \text{ kg}
 \end{aligned}$$

Check whether the calculated amount is more than 26 x LFL = 26 x 0.038 = 0.99 kg. In this case, the $m_{\max}$ is less than 0.99 kg. Therefore, 0.41 kg is the maximum allowable charge size.

TABLE A1

Maximum allowable charge size of R-32 in Air-Conditioning equipment

Area (m ²)	M _{max} Floor Location (kg)	M _{max} Window Mounted (kg)	M _{max} Wall Mounted (kg)	M _{max} Ceiling Mounted (kg)
9	1.03	1.71	3.09	3.77
12	1.19	1.98	3.56	4.35
15	1.33	2.21	3.98	4.87
18	1.45	2.42	4.36	5.33
21	1.57	2.62	4.71	5.76
24	1.68	2.80	5.04	6.16
27	1.78	2.97	5.34	6.53
30	1.88	3.13	5.63	6.88
33	1.97	3.28	5.91	7.22
36	2.06	3.43	6.17	7.54
39	2.14	3.57	6.42	7.85
42	2.22	3.70	6.66	8.15
45	2.30	3.83	6.90	8.43
48	2.37	3.96	7.12	8.71
51	2.45	4.08	7.34	8.98
54	2.52	4.20	7.56	9.24
57	2.59	4.31	7.76	9.49
60	2.66	4.43	7.97	9.74

The RAC servicing technician must ensure that the actual charge size of refrigerant in the AC system being installed/serviced does not exceed the maximum charge size.

TABLE A2

Maximum allowable charge size of R-290 in Air-Conditioning equipment

Area (m ²)	M _{max} Floor Location (kg)	M _{max} Window Mounted (kg)	M _{max} Wall Mounted (kg)	M _{max} Ceiling Mounted (kg)
9	0.08	0.13	0.23	0.28
12	0.09	0.15	0.26	0.32
15	0.10	0.16	0.29	0.36
18	0.11	0.18	0.32	0.39
21	0.12	0.19	0.35	0.42
24	0.12	0.21	0.37	0.45
27	0.13	0.22	0.39	0.48
30	0.14	0.23	0.41	0.51
33	0.14	0.24	0.43	0.53
36	0.15	0.25	0.45	0.55
39	0.16	0.26	0.47	0.58
42	0.16	0.27	0.49	0.60
45	0.17	0.28	0.51	0.62
48	0.17	0.29	0.52	0.64
51	0.18	0.30	0.54	0.66
54	0.18	0.31	0.55	0.68
57	0.19	0.32	0.57	0.70
60	0.19	0.32	0.58	0.71

The RAC servicing technician must ensure that the actual charge size of refrigerant in the AC system being installed/serviced does not exceed the maximum charge size.

A-2.2: Required Minimum Floor Area

When a RAC servicing technician installs a system with a flammable refrigerant charged with a particular quantity of refrigerant 'm', in kg, the required minimum floor area ('A_{min}') should be calculated using the following formula:

$$A_{\min} = \left(\frac{m}{2.5 \times \text{LFL}^{1.25} \times h_0} \right)^2$$

This formula can be applied when the range of the charge size is between:

- o (6 x LFL) to (39 x LFL) for flammability class 2L
- o (4 x LFL) to (26 x LFL) for flammability class 2 & 3

There are no room volume restrictions when the refrigerant charge is:

- o below or equal to (6 x LFL) for flammability class 2L
- o below or equal to (4 x LFL) for flammability class 2 & 3

TABLE A3

Minimum floor area requirements

	No Volume Restriction	A _{min} Formula should be Applied
R-32	charge size ≤ 1.8 kg	Between 1.8 and 12.0 kg
R-290	charge size ≤ 0.15 kg	Between 0.15 and 1.0 kg

TABLE A4

Minimum floor area requirement of R-32 in Air-Conditioning equipment

Actual Charge Size (kg)	A _{min} Floor Location (m ²)	A _{min} Window Mounted (m ²)	A _{min} Wall Mounted (m ²)	A _{min} Ceiling Mounted (m ²)
Less than 1.8 kg	No Volume Restriction			
1.8	27.6	9.9	3.1	2.1
2.0	34.0	12.3	3.8	2.5
2.2	41.2	14.8	4.6	3.1
2.4	49.0	17.6	5.4	3.6
2.6	57.5	20.7	6.4	4.3
2.8	66.7	24.0	7.4	5.0
3.0	76.6	27.6	8.5	5.7
3.2	87.2	31.4	9.7	6.5
3.4	98.4	35.4	10.9	7.3
3.6	110.3	39.7	12.3	8.2

3.8	122.9	44.2	13.7	9.1
4.0	136.2	49.0	15.1	10.1
4.2	150.1	54.0	16.7	11.2
4.4	164.8	59.3	18.3	12.3
4.6	180.1	64.8	20.0	13.4
4.8	196.1	70.6	21.8	14.6
5.0	212.8	76.6	23.6	15.8

TABLE A5

Minimum floor area requirement of R-290 in Air-Conditioning equipment

Actual Charge Size (kg)	A _{min} Floor Location (m ²)	A _{min} Window Mounted (m ²)	A _{min} Wall Mounted (m ²)	A _{min} Ceiling Mounted (m ²)
Less than 0.15 kg	No Volume Restriction			
0.15	35.5	12.8	3.9	2.6
0.20	63.2	22.7	7.0	4.7
0.25	98.7	35.5	11.0	7.3
0.30	142.1	51.2	15.8	10.6
0.35	193.4	69.6	21.5	14.4
0.40	252.6	90.9	28.1	18.8
0.45	319.7	115.1	35.5	23.8
0.50	394.7	142.1	43.9	29.4
0.55	477.6	171.9	53.1	35.5
0.60	568.4	204.6	63.2	42.3
0.65	667.1	240.2	74.1	49.6
0.70	773.7	278.5	86.0	57.5
0.75	888.1	319.7	98.7	66.1
0.80	1,010.5	363.8	112.3	75.2
0.85	1,140.8	410.7	126.8	84.9
0.90	1,278.9	460.4	142.1	95.1
0.95	1,425.0	513.0	158.3	106.0

Annex II



REGISTRATION
FORM

Annex III



PRE-APPLICATION
FORM

Annex IV



SUMMARY OF IMPORTING
& REPORTING
INFORMATION AND
SUMMARY OF
DISTRIBUTION

Annex V



DETAILS OF SHIPMENT
FORM

**Tumasek Plaza Building, Raja Isteri Pengiran Anak Saleha Road,
Bandar Seri Begawan, BA1910, Negara Brunei Darussalam**

Tel: 673-2241262 | Fax: 673-2241290

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