

3	MATERIALS ASPECTS	3.2 SELECTION OF MATERIALS	1
		MA 8 OZONE DEPLETING SUBSTANCES	
	EXCLUSIONS	None.	
	OBJECTIVE	Reduce the release of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) into the atmosphere.	
	CREDITS ATTAINABLE	2	
	PREREQUISITES	Compliance with the Ozone Layer Protection Ordinance Chapter 403.	
	CREDIT REQUIREMENT	<p>a) Refrigerants</p> <p>1 credit for the use of refrigerants with a value less than or equal to the threshold of the combined contribution to ozone depletion and global warming potentials using the specified equation.</p> <p>b) Ozone depleting materials</p> <p>1 credit for the use of products in the building fabric and services that avoid using ozone depleting substances in their manufacture, composition or use.</p>	
	ASSESSMENT	<p>a) Refrigerants</p> <p>The air-conditioning and refrigeration equipments shall fulfill the following equation which determines a maximum threshold for the combined contributions to ozone depletion and global warming potentials:</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> $LCGWP + LCODP \times 10^5 \leq 775$ </div> <p> $LCGWP = [GWPr \times (Lr \times Life + Mr) \times Rc] / Life$ $LCODP = [ODPr \times (Lr \times Life + Mr) \times Rc] / Life$ $LCGWP = \text{Lifecycle Global Warming Potential (kg CO}_2\text{ /kw -Yr)}$ $LCODP = \text{Lifecycle Ozone Depletion Potential (kg CFC 11/kw-Yr)}$ $GWPr = \text{Global Warming Potential of Refrigerant (0 to 12,000 kg CO}_2\text{ /kg r)}$ $ODPr = \text{Ozone Depletion Potential of Refrigerant (0 to 0.2 kg CFC 11 /kg r)}$ $Lr = \text{Refrigerant Leakage Rate (0.5\% to 2.0\%; default of 2\% unless otherwise demonstrated)}$ $Mr = \text{End-of-life Refrigerant Loss (2\% to 10\%; default of 10\% unless otherwise demonstrated)}$ $Rc = \text{Refrigerant Charge (0.2 to 2.3 kg of refrigerant per kW of gross ARI rated cooling capacity)}$ $Life = \text{Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated)}$ </p>	A1
		<p>For systems with different types of equipment, a weighted average of all air-conditioning and refrigeration equipments shall be calculated using the following equation:</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> $[\sum (LCGWP + LCODP \times 10^5) \times Q_{unit}] / Q_{total} \leq 775$ </div> <p> $Q_{unit} = \text{Gross ARI rated cooling capacity of an individual air-conditioning or refrigeration unit (kW)}$ $Q_{total} = \text{Total gross ARI rate cooling capacity of all air-conditioning or refrigeration (kW)}$ </p>	A2

Small air-conditioning units, defined as those containing less than 0.23 kg of refrigerant, and other equipment, such as standard refrigerators, small water coolers and any other cooling equipment that contains less than 0.23 kg of refrigerant, can be excluded from this assessment.

The Client shall submit a report by a suitably qualified person giving details of the air-conditioning and refrigeration equipment installed; and demonstrating that the global warming potential and ozone depletion potential of the refrigerants used in equipment meets the specified requirement. Reference shall be made to refrigerant supplies and/or equipment manufacturer's data together with guidance provided by recognised authorities such as ASHRAE, CIBSE, etc.

A3

b) Ozone depleting materials

The Client shall provide a full description and specifications of all major thermal insulation and fire retardant materials specified in roof constructions, walls, chilled water pipes, refrigerant pipes, ductwork, etc., advising the presence or otherwise of ozone depleting agents. Where there is any doubt as to the ozone depletion potential of a material or product, the Client shall ascertain details from the supplier. Credit will be awarded where demonstration of reasonable effort has been made to avoid the use of products that have significant ozone depletion potential.

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B2

B3

BACKGROUND

The Montreal Protocol has scheduled the phasing out of controlled substances, including chemicals containing chlorine and bromine used as refrigerants, solvents, foam blowing agents, aerosol propellants, fire suppressants, and for other purposes. Ozone Layer Protection Ordinance (Cap. 403) 1989 [1] gives effect to Hong Kong's international obligations to control the manufacture, import and export of ozone depleting substances. Ozone Layer Protection (Controlled Refrigerants) Regulation 1994 [2] requires the conservation of controlled refrigerants used in large scale installations and motor vehicles. Ozone Layer Protection (Products Containing Scheduled Substances) (Import Banning) Regulation 1993 [3] prohibits the import of portable fire extinguishers containing halons and other controlled products from a country or place not a party to the Montreal Protocol unless the Authority considers that it complies with the requirements of the Protocol. Scheduled substances under the Ozone Layer Protection Ordinance are listed by the Environmental Protection Department.

In addition to having suitable thermodynamic properties, the ideal refrigerant would be nontoxic, non-inflammable, completely stable, environmentally benign, readily available, self-lubricating, compatible with materials used in equipment, easy to handle and detect. No current refrigerants are ideal. Compounds that contain no chlorine or bromine have ozone depletion potential (ODP) nearly zero. Increasing the amount of fluorine generally raises the global warming potential (GWP). Hydrogen content tends to shorten the atmospheric lifetime [4].

Climate change is much more complex than ozone depletion, yet there is wide agreement that warming is occurring. While refrigerants contribute to global environmental concerns, the impact is comparatively small [4]. The problem is not with refrigerants inside air-conditioning systems, but with their release. Given that ODP is largely addressed by legislation, BEAM basis assessment of refrigerants is based on GWP.

- 1 Environmental Protection Department. A Concise Guide to the Ozone Layer Protection Ordinance. http://www.epd.gov.hk/epd/english/laws_regulations/comp_guides/files/cgto_olpo_eng.pdf
- 2 Environmental Protection Department. A Concise Guide to the Ozone Layer Protection (Controlled Refrigerants) Regulation. http://www.epd.gov.hk/epd/english/laws_regulations/comp_guides/files/cgt_olp_cr_eng.pdf
- 3 Environmental Protection Department. Ozone Layer Protection Ordinance Scheduled Substance. http://www.epd.gov.hk/epd/english/application_for_licences/guidance/wn6_licen1_1.html
- 4 Calm S M. Option and Outlook for Chiller Refrigerants. International Journal of Refrigeration. Vol. 25, 2002, pp 705-715.

CFCs generally have high ODP and GWP. HCFCs generally have much lower ODP and GWP. HFCs offer near-zero ODP but some have comparatively high GWPs.

Refrigerant	ODP ^[1]	GWP ^[1]
Hydrofluorocarbons		
HFC-23	~0	12240
HFC-32	~0	650
HFC-134a	~0	1320
HFC-152a	~0	140
HFC-402A	~0	1680
HFC-404A	~0	3900
HFC-407C	~0	1700
HFC-410A	~0	1890
HFC-413A	~0	1774
HFC-507A	~0	3900
Hydrochlorofluorocarbons		
HCFC-22	0.04	1780
HCFC-123	0.02	76
Chlorofluorocarbons		
CFC-11	1.0	4680
CFC-12	1.0	10720
CFC-114	0.94	9800
CFC-500	0.605	7900
CFC-502	0.221	4600
[1] – Sources: i: IPCC Second Assessment Report; ii: "World Resources Institute (2005), World Business Council for Sustainable Development"; iii: U.S. Environmental Protection Agency.		

The U.S. Environmental Protection Agency provides information on suitable substitutes for ozone depleting substances [5], including refrigerants for various types of air-conditioning and refrigeration equipment, fire suppression [6], blowing agents [7], solvents, etc. CIBSE GN01 [8] outlines the hazards of using these refrigerants and provides design guidance for refrigeration systems, thermal insulation and fire protection systems. An ASHRAE guideline [9] recommends practices and procedures that will reduce inadvertent release of halogenated refrigerants. The practices and procedures in this guideline cover emission reduction of halogenated hydrocarbon and halogenated ether refrigerants:

- from stationary refrigeration, air-conditioning, and heat pump equipment and systems; and
- during manufacture, installation, testing, operation, maintenance, and disposal of equipment and systems.

5 U.S. Environmental Protection Agency. <http://www.epa.gov/docs/ozone/snap/lists/index.html#refac>

6 U.S. Environmental Protection Agency. <http://www.epa.gov/ozone/snap/fire/index.html>

7 U.S. Environmental Protection Agency. <http://www.epa.gov/docs/ozone/snap/foams/lists/index.html>

8 Chartered Institution of Building Services Engineers. CFC's, HCFC's, HFC's and halons. 2000. ISBN 0900953993.

9 ASHRAE Guideline 3-1996. Reducing Emission of Halogenated Refrigerants in Refrigeration and AS