

The AGC logo is positioned in the top right corner of the image. It consists of the letters 'AGC' in a bold, blue, sans-serif font. A small red square is located between the 'G' and 'C'.

**Dramatically Reducing GWP
with Superior Performance**

The AMOLEA logo is located in the bottom right area of the image. It features a stylized green and blue circular icon to the left of the word 'AMOLEA' in a blue, italicized, sans-serif font. A small 'TM' trademark symbol is at the end.

Your Dreams, Our Challenge

Introduction

Hydrofluorocarbons (HFCs) were originally developed as refrigerant substitutes for ozone depleting substances such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). However, HFCs have a relatively high global warming potential (GWP) so in an effort to consume less HFCs, AGC Chemicals launched a next-generation refrigerant, AMOLEA™ 1224yd, with the goal of reducing environmental impact.

AMOLEA™ 1224yd is a non-flammable refrigerant consisting of R1224yd(Z), for use in centrifugal chillers, binary cycle generators and waste heat recovery pumps. With an Ozone Depleting Potential (ODP) of almost zero and a GWP value less than 1, it has little impact on the natural environment. Given that its physical properties match closely those of R245fa and R1233zd(E), it is suitable for retrofitting to existing equipment without major changes of equipment design.

With improved chemical and thermal stability compared to R123, HFOs and HCFOs it also offers good compatibility with most metals, plastics, lubricating oils and elastomers. AMOLEA™ 1224yd is ideal for use as an alternative to or replacement for R245fa and R123, since its comparable performance is equivalent or superior. It also offers considerable energy savings.

AGC continuously collaborates with equipment manufacturers to improve refrigeration, freezing and air conditioning products to ensure the lowest possible impact on the environment.

Features

- Low Global Warming Potential (GWP) < 1*
- Almost zero* Ozone Depleting Potential (ODP)
- Chemical & thermal stability
- Good performance
- Low toxicity
- Non-flammability
- Good compatibility with metals, plastics, lubricating oils & elastomers
- ASHRAE certification A1

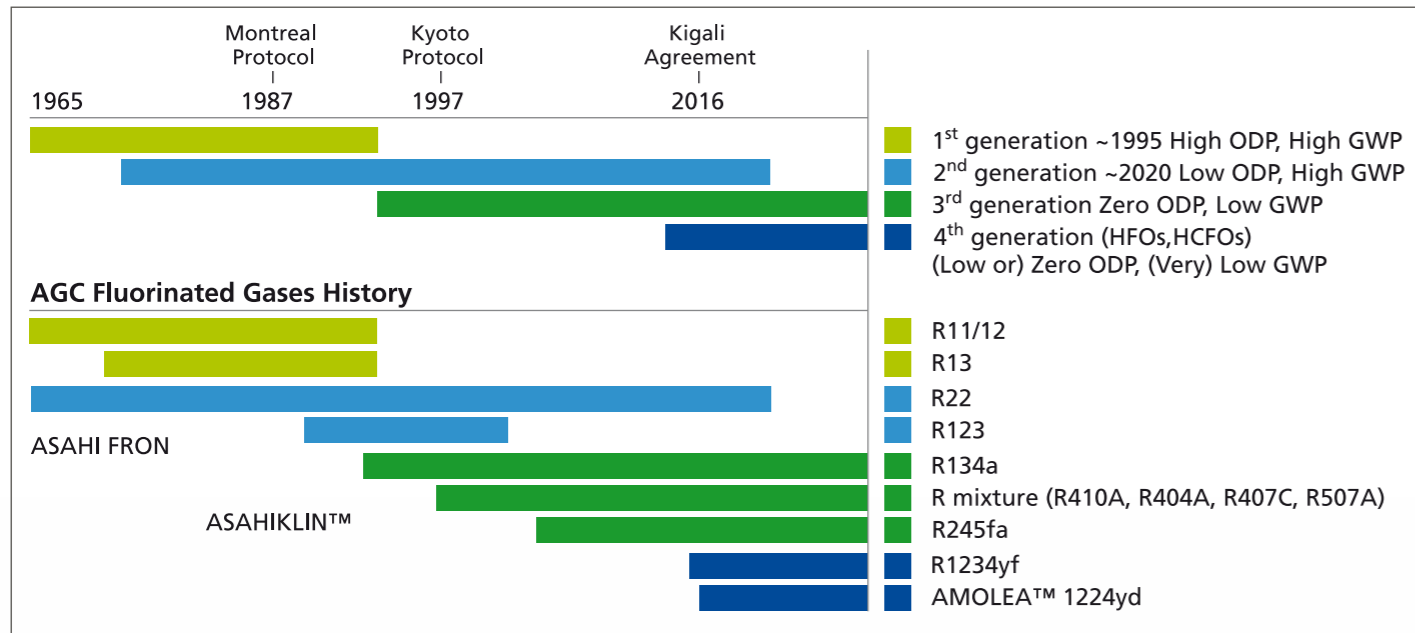
Applications

- Centrifugal chillers
- Blowing agent for urethane foaming
- Heat pumps
- Binary cycle power generation
- Rankine cycle power generation



*Measured by the Japanese Institute of Advanced Industrial Science and Technology (AIST)

Refrigerants over the Years

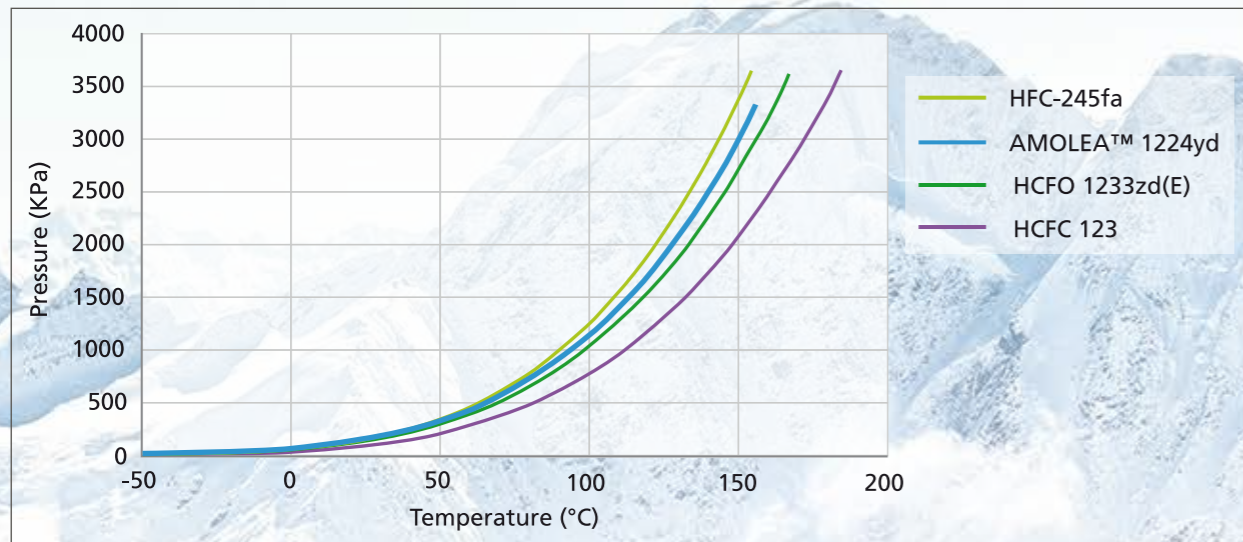


The Concept of AMOLEA™ 1224yd



Saturated Vapour Pressure

AMOLEA™ 1224yd saturated vapor pressure is a little lower than that of R245fa. Therefore, refrigerants can be replaced without making changes to the design pressure of R245fa.



Thermal Stability

Refrigerant	R123	R245fa	AMOLEA™ 1224yd
Test temperature	175°C		
Test time	14 days		
Refrigerant acid content (ppm, as HF)	Unmeasurable due to excessive degradation	<1	<1
Degree of metal corrosion (mg/dm ² /day)	SS	Significant decomposition	<5
	Cu		<5
	Al		<5
	Mg		<5
	Ni		<5
	Zn		<5
SUS304	n.d.	<5	

Lubricants

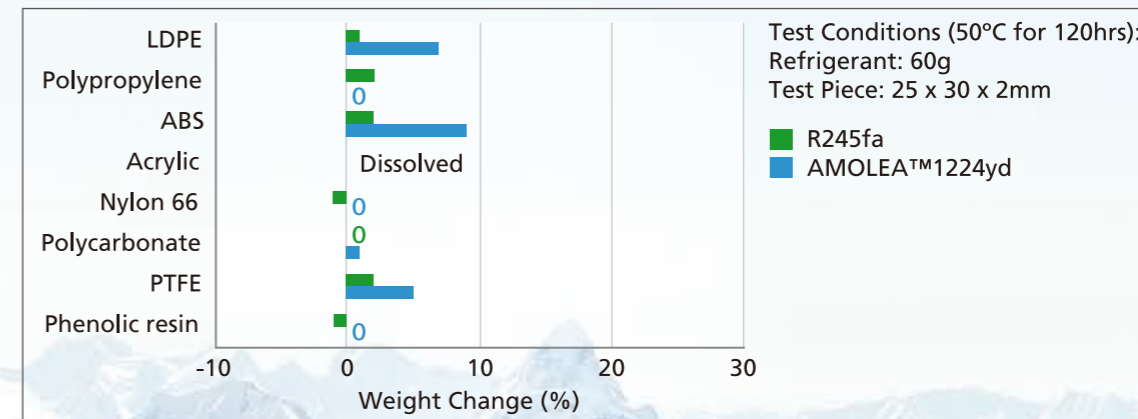
AMOLEA™ 1224yd is miscible with refrigeration oils, such as POE (used with HFC refrigerants at arbitrary temperatures) and also with naphthenic oils that are used with HCFC refrigerants at various temperatures.

AMOLEA™ 1224yd performs well with these lubricants and others, even with concomitant air or moisture.

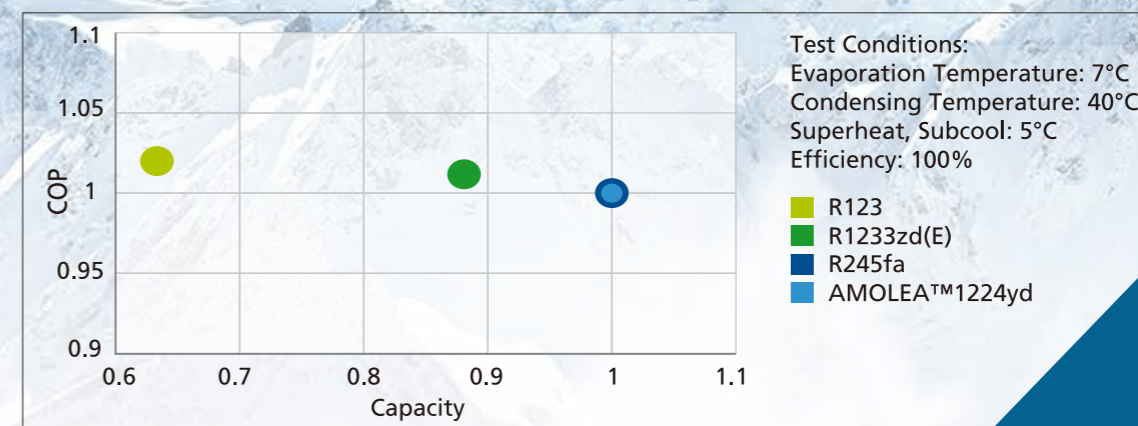
Lubricant manufacturers can offer advice about the possible need to use stabilisers, anti-abrasion agents or other additives depending on the operating conditions.

Lubricants	POE	Naphthenic mineral oil	Alkyl benzene oil
Amolea™ 1224yd mutual miscibility	Low temperature	<-40°C	-16°C
	High temperature	>40°C	>40°C

Compatibility with Plastics



Theoretical Refrigeration Capacity (Relative COP, Relative Performance)



AMOLEA™ 1224yd Physical Properties	
Chemical name	(Z)-1-Chloro-2,3,3,3-Tetrafluoropropane
Molecular formula	(Z)-CF ₃ -CF=CHCl
Molecular weight	148.5 g/mol
Normal boiling point (101.3kPa)	14°C
Critical temperature	156°C
Critical pressure	3.34 MPa
Critical density	527 kg/m ³
LC50	213,000 ppm
Atmospheric lifetime	20* days
ODP	0.00023*
GWP	<1
Flammable range	none

Comparison of Grades					
	Unit	R123	R245fa	AMOLEA™ 1224yd	R1233zd(E)
Molecular formula		CHCl ₂ CF ₃	CF ₃ CH ₂ CHF ₂	CF ₃ CF=CHCl	CF ₃ CH=CHCl
Molecular weight	g/mol	152.9	134.0	148.5	130.5
Normal boiling point (101.3kPa)	°C	28	15	14	18
Critical temperature	°C	183.7	153.9	155.5	166.6
Critical pressure	MPa	3.66	3.65	3.34	3.62
Critical density	kg/m ³	550	519	527	480
Freezing point	°C	-107	-105	-115	-107
Vapour pressure (25°)	kPa	91.4	149	149	130
Vapour density (25°)	kg/m ³	5.87	8.55	9.47	7.19
Liquid density (25°)	kg/m ³	1464	1339	1361	1263
Latent heat of vaporisation (25°)	kJ/kg	171.4	191.2	164.0	191.8
Heat capacity ratio (25°C, 1atm)	-	1.445	1.094	1.098	1.104
Solubility of water (25°)	ppm	632	1600	290	460
Volume resistivity	Ω·cm	1.5×10 ⁸	2.0×10 ⁹	5.7×10 ⁹	n.d.
Flammable range	vol%	none	none	none	none
ODP (CFC-11=1)	-	0.02	0	0.00023*	0.00024
GWP (CO=1,100TH)	-	77	1030	<1*	1
Atmospheric lifetime	-	1.3 years	7.7 years	20 days	26 days
AEL	ppm	50	300	1000	800
ASHRAE classification	-	B1	B1	A1	A1
CAS no.	-	306-83-2	460-73-1	111512-60-8	102687-65-0
TSCA	-	registered	registered	applied	registered

*Measured by the Japanese Institute of Advanced Industrial Science and Technology (AIST)

**Value confirmed by the Occupational Alliance for Risk Science (OARS) using Workplace Environmental Exposure Levels (WEELs)

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