



Your Dreams, Our Challenge

Dramatically Reducing GWP with Superior Performance

AMOLEA™ 1224yd

With Ozone Depleting Potential (ODP) of almost zero and a GWP value under 1, AMOLEA™1224yd has less environmental impact compared to HFCs. Its physical properties are similar to those of HFC-245fa. Furthermore, it has good chemical / thermal stability and compatibility with most commonly used metals, plastics, and elastomers.

AGC proposes AMOLEA™1224yd as a refrigerant complying with domestic and overseas environmental regulations for use in centrifugal chillers, binary cycle generators, waste heat recovery heat pumps, blowing agent, aerosol solvent and cleaning solvent.

Zero-ODP

Stability

Performance

Low-toxicity

Non-flammable

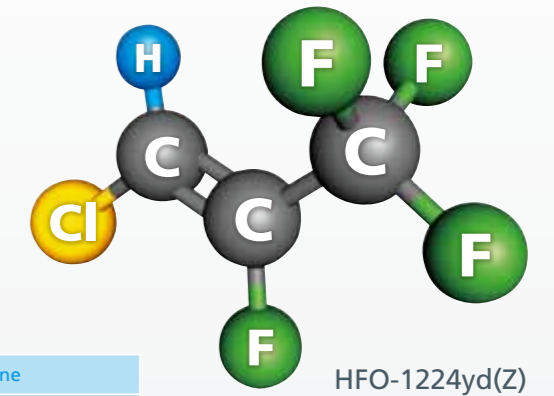
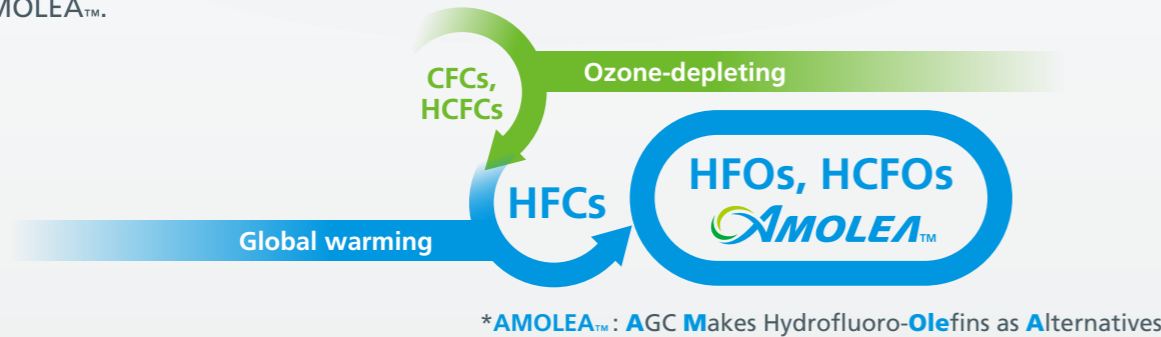
GWP₁

1000

What is AMOLEA™ 1224yd ?

Concept

AMOLEA™ is the next-generation solvent / refrigerant brand developed in AGC Chemicals, with the goal of "Dramatically Reducing GWP with Superior Performance."
AGC contributes to the creation of an environmental friendly society through the development of AMOLEA™.



Properties

AMOLEA™1224yd (R-1224yd(Z))

Chemical name	(Z)-1-Chloro-2,3,3,3-tetrafluoropropene
Molecular formula	(Z)-CF ₃ CF=CHCl
Molecular weight	148.5 g/mol
Normal boiling point (101.3kPa)	15 °C
Critical temperature	156 °C
Critical pressure	3.34 MPa
Critical density	527 kg/m ³
LC ₅₀	213,000 ppm
Atmospheric Lifetime	20 days*
ODP (CFC-11=1)	0.00023*
GWP (IPPC AR5) (CO ₂ =1)	<1*
Flammable range	None
Flash point	None

*Tokuhashi K. et al., *J. Phys. Chem. A*, (2018) 122, 3120-3127

Features

- GWP under 1*
- Zero-ODP (0.00023 as CFC=11*)
- Chemical and physical properties similar to HFC-245fa
- Good compatibility with various oils, metals, plastics, and elastomers.
- Low toxicity (LC₅₀>213,100 ppm, AEL=1,000 ppm)
- Non-Flammable (ASTM E681)
- ASHRAE 34 certified refrigerant (R-1224yd(Z))

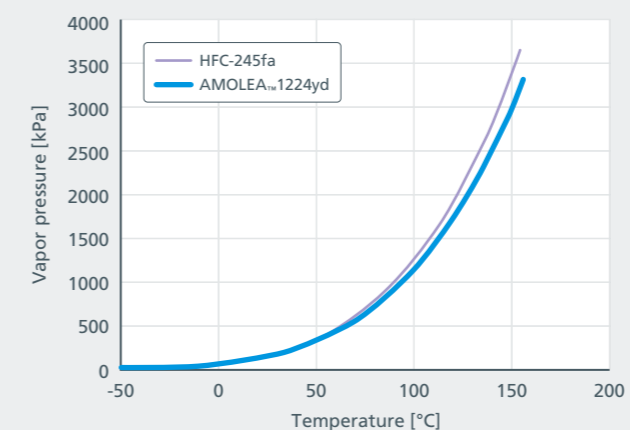
*Tokuhashi K. et al., *J. Phys. Chem. A*, (2018) 122, 3120-3127

Application

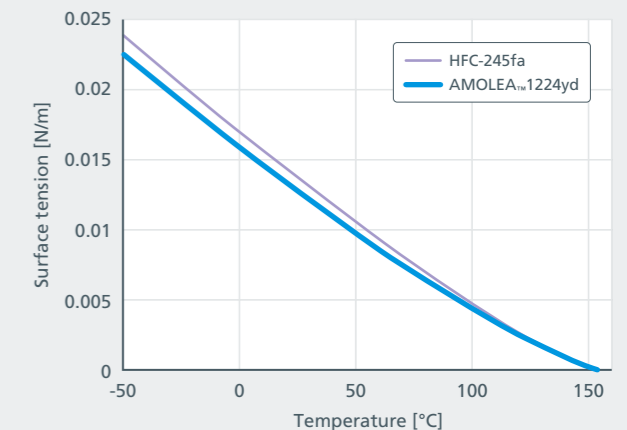
- Centrifugal Chiller
- High-temperature heat pumps
- Organic Rankine Cycle (e.g. Binary cycle)
- Blowing agent
- Aerosol solvent
- Solvent



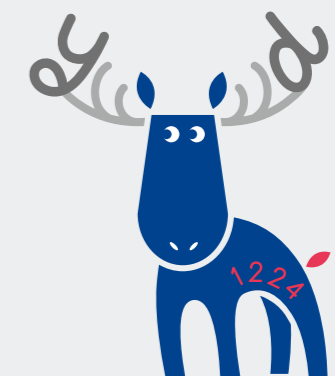
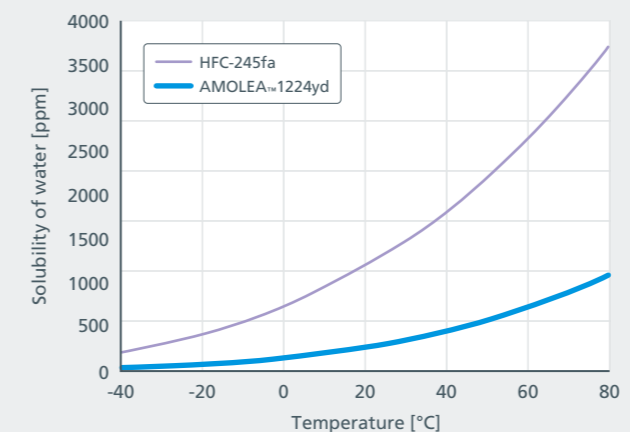
Vapor pressure



Surface tension



Solubility of water



Thermal stability

AMOLEA™1224yd is thermally stable and does not easily decompose. The effects of lubricating oils, metals, insulation materials, resins, elastomers, drying agents, moisture, and air all need to be considered.

As shown in the following tables, the thermal stability of AMOLEA™1224yd is equivalent to those of HFC-245fa. As a refrigerant, it delivers excellent performance to ensure longer operation with less maintenance.

Stability with metals

[Conditions] Refrigerant:60g, Metal pieces:25x30x2mm

Refrigerant	AMOLEA™1224yd	HFC-245fa
Aging temp.	175 °C	175 °C
Aging time	14 days	14 days
Acidity of refrigerant [ppm as HF]	<1	<1
Degree of corrosion [mg/dm ² /day]	SS	<5
	Cu	<5
	Al	<5
	Mg	<5
	Ni	<5
	Zn	<5
SUS304	<5	<5

Stability with metals and oils

[Conditions] Refrigerant:30g, oils:30g, Metal pieces:25x30x2mm

Refrigerant	AMOLEA™1224yd	HFC-245fa	AMOLEA™1224yd	HCFC-123
Type of Oil	POE	POE	Naph.*	Naph.*
Temp.	175 °C	175 °C	175 °C	175 °C
Aging time	14 days	14 days	14 days	14 days
Acidity of refrigerant [ppm as HF]	<1	<1	1	>20,000
Appearance	Clear	Clear	Clear	Cloudy
Oil color [ASTM]	0.2	0.2	0.8	9.9
Acidity of oil [mgKOH/g]	<0.01	<0.03	<0.01	0.08
Degree of corrosion [mg/dm ² /day]	SS	<5	<5	<5
	Cu	<5	<5	10
	Al	<5	<5	>+100

*Naph. = Naphthenic mineral oil

Stability with moisture, air, and oils

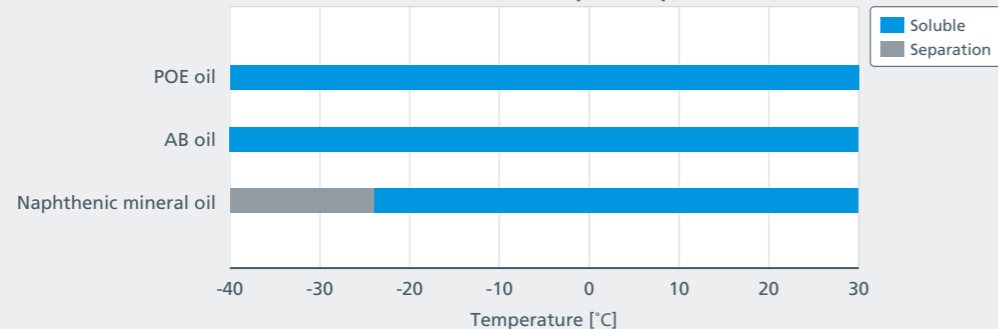
[Conditions] Refrigerant:30g, oils:30g, Metal pieces:25x30x2mm

Refrigerant	AMOLEA™1224yd	HFC-245fa
Type of Oil	POE	POE
Water	1,000 ppm	1,000 ppm
Air	1,000 ppm	1,000 ppm
Temperature	175 °C	175 °C
Aging time	14 days	14 days
Acidity of refrigerant [ppm as HF]	<1	<1
Appearance	Clear	Clear
Oil color [ASTM]	0.3	0.1
Acidity of oil [mgKOH/g]	0.1	0.01
Degree of corrosion [mg/dm ² /day]	SS	<5
	Cu	<5
	Al	<5
Deposit	None	None

Miscibility with oils

AMOLEA™1224yd shows acceptable miscibility with synthetic oils such as polyol ester oils (POEs) which are often used for HFCs over a wide range of temperatures. Also, AMOLEA™1224yd has mutual solubility with naphthenic oils, and alkyl benzene oils which are often used for HCFCs in practical temperature ranges.

[Conditions] Oil concentration:10wt%



Material compatibility

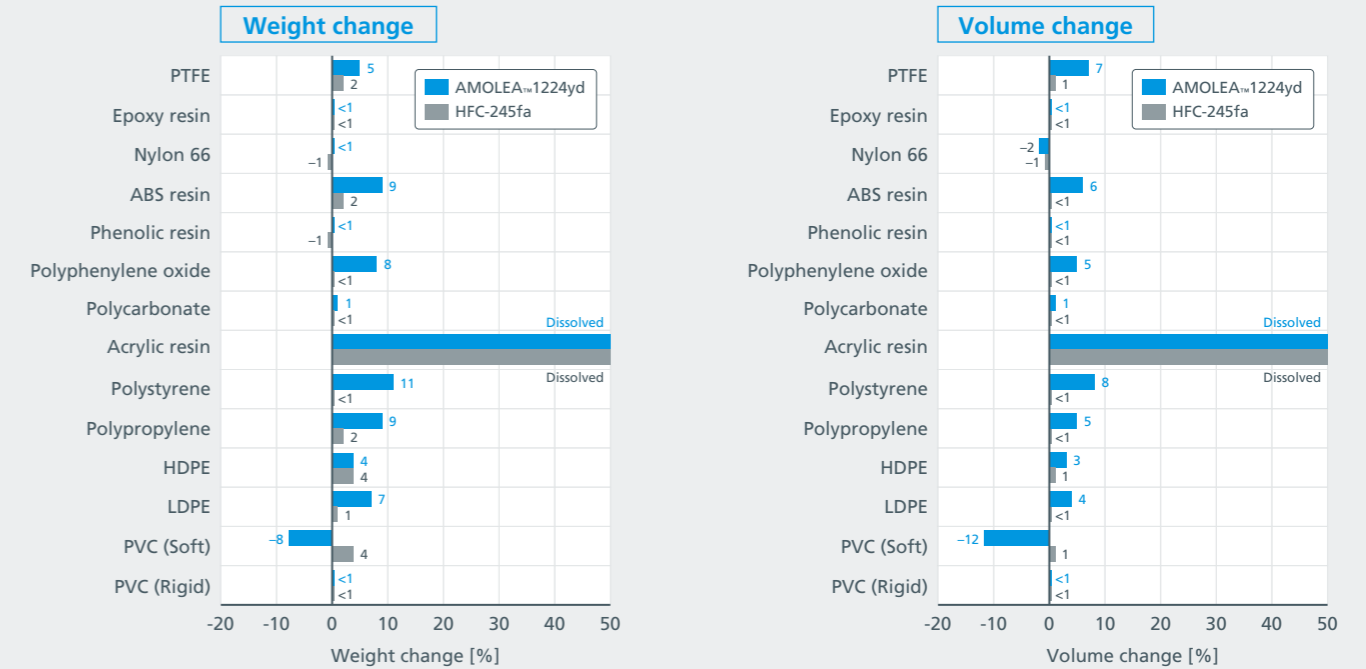
As shown in the following tables, the impact of plastics on AMOLEA™1224yd is almost the same as that of HFC-245fa. However, use of acrylic resin is NOT suitable for with AMOLEA™1224yd. The impact of commonly used elastomers on AMOLEA™1224yd is equivalent to HFC-245fa.

In general, plastics and elastomers have different characteristics, depending on the types and amounts of additives and their processing conditions. In addition, the impact of coexisting materials such as lubricating oils also needs to be considered.

These data are the results based on limited samplings. Customers should confirm the compatibility of individual samples prior to the actual usage.

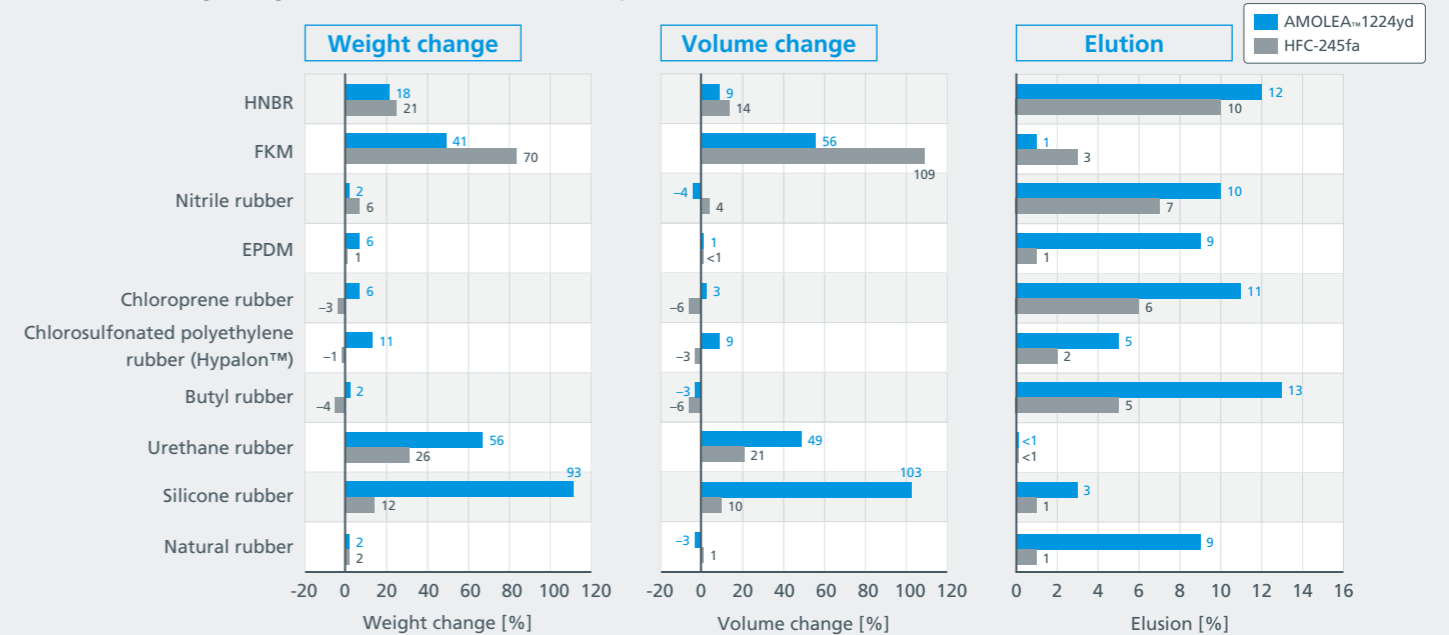
Compatibility with Plastics

[Conditions] Refrigerant:60g, plastics:25x30x2mm, 50°Cx120 hours, Liquid immersion



Compatibility with Elastomers

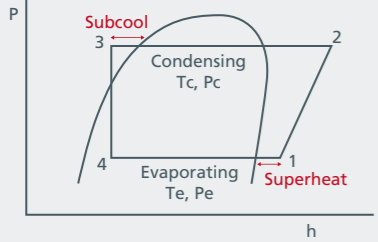
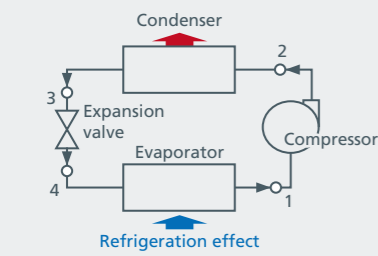
[Conditions] Refrigerant:60g, elastomers:25x30x2mm, 50°Cx120 hours, Liquid immersion



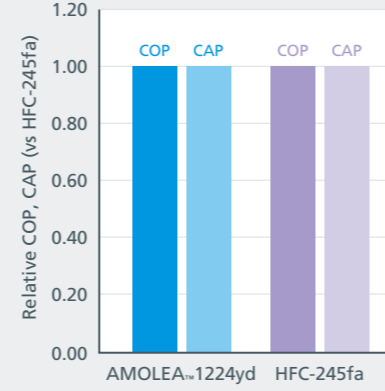
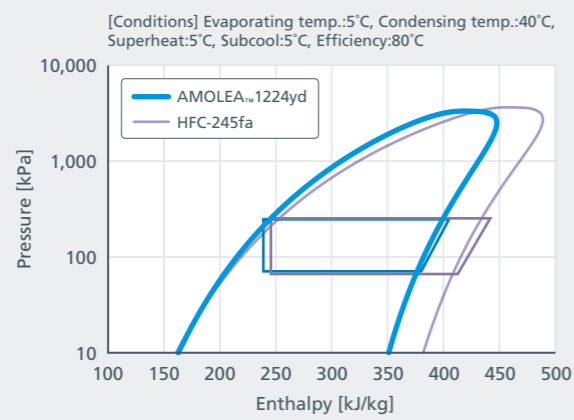
Performance: Centrifugal Chiller

AMOLEA™1224yd has the same performance as HFC-245fa based on both theoretical performance and actual machine evaluation.

Theoretical performance



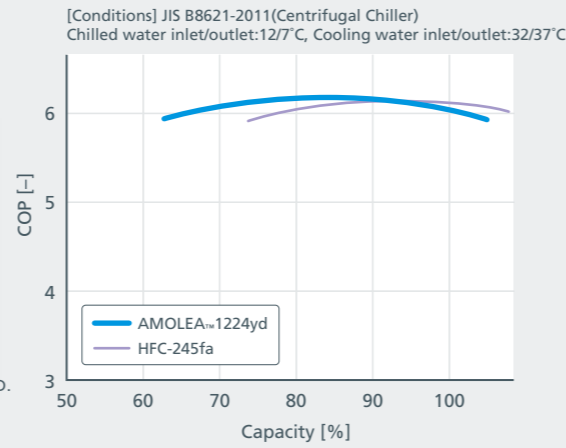
[Theoretical formula(Chiller)]
 $COP = (h1 - h4) / (h2 - h1)$
 $CAP = (h1 - h4) * \rho$



Actual machine performance



Centrifugal chiller manufactured by EBARA REFRIGERATION EQUIPMENT&SYSTEMS CO.,LTD.

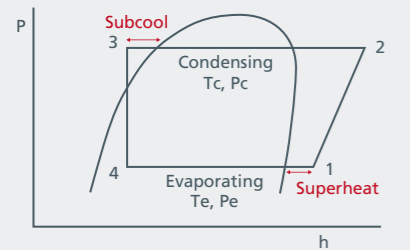
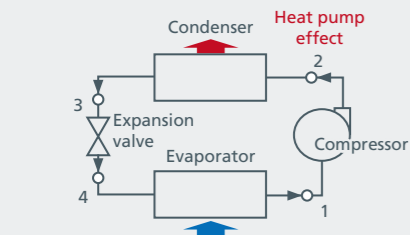


*Amano, S., *kenchikusetsubi to haikansenjyo*, August, 2017. (in Japanese)

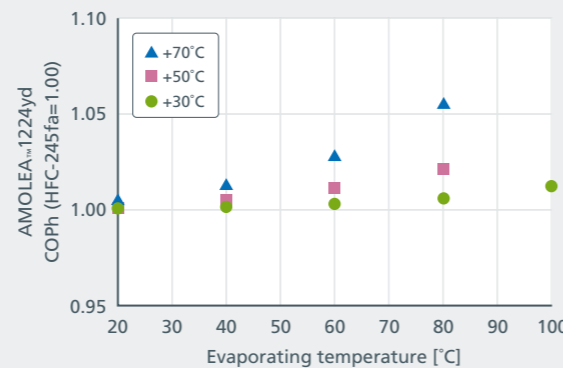
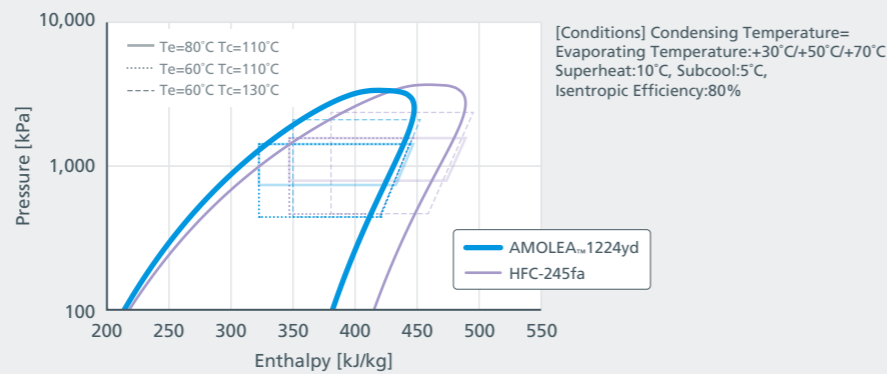
Performance: High-temperature heat pumps

AMOLEA™1224yd has confirmed that it has the same or better performance(COPh) as HFC-245fa based on theoretical performance estimation.

Theoretical performance



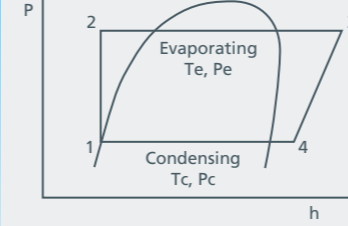
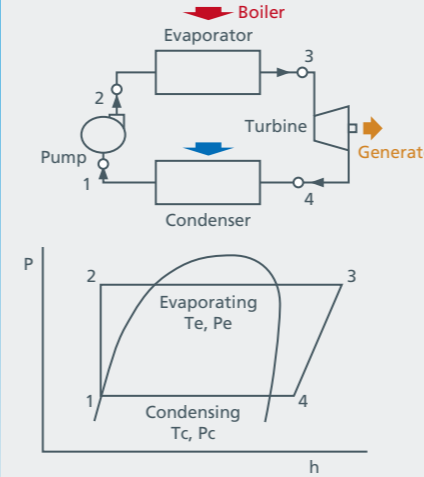
[Theoretical formula(heat pump)] $COPh = (h2 - h3) / (h2 - h1)$



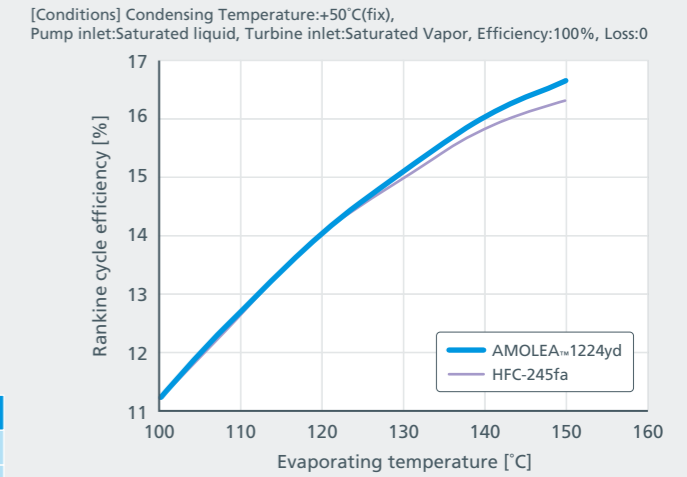
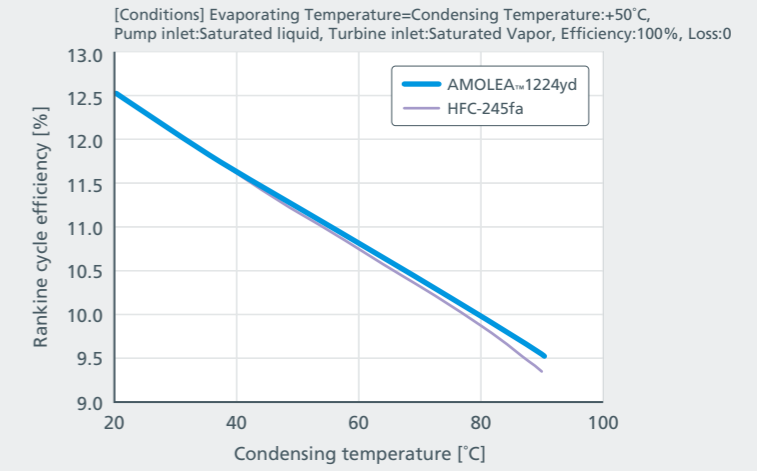
Performance: Organic Rankine cycle (ORC)

AMOLEA™1224yd has the same efficiency as HFC-245fa based on theoretical performance estimation.

Theoretical performance



[Theoretical formula] Rankine cycle efficiency: $((h3 - h4) - (h2 - h1)) / (h3 - h2)$



Combustion properties

AMOLEA™1224yd is a safe fluid with no flash point and no flammable range.

Contents	AMOLEA™1224yd
Flash point	None
Flammable range	None

Environmental Impact

According to various types of toxicity data, AMOLEA™ 1224yd has lower toxicity than that of HFC-245fa. AMOLEA™1224yd has been submitted for registration as "A1" under the ASHRAE 34 safety classification, as an A1 refrigerant. In addition, the ODP of AMOLEA™1224yd is considered to be equivalent to zero, with a GWP value of less than 1, calculated according to the IPCC AR5 method. Thus, you can drastically reduce environmental impact by converting to AMOLEA™1224yd.

Refrigerant	HFO			HFC
	AMOLEA™1224yd	HFO-1233zd(E)	HFO-1336mzz(Z)	245fa
ASHRAE Classification	A1	A1	A1	B1
AEL [ppm]	1000	800	500	300
ODP (CFC-11=1)	0.00023*	0.00024	0	0
GWP (IPCC AR5) (CO ₂ =1)	0.88*	1	2	858
MOP HFC regulation	N.A.	N.A.	N.A.	Applicable
EPA-SNAP	Registered (for Chiller)	Registered	Registered	Unacceptable for new equipment
REACH	Registered	Registered	Registered	Registered
China REACH	Applying	Registered	Registered	Registered

*Tokunashi K. et al., *J. Phys. Chem. A*, (2018) 122, 3120-3127



**Chemistry
for a Blue Planet**
AGC Chemicals

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The data described in this document is an example of actual measurement values.
AGC Chemicals will not guarantee or be responsible for patents and accident damages using this data.
Please carefully confirm the AMOLEA™ 1224yd Safety Data Sheet (SDS) for further evaluation.



AMOLEA™ 1224yd
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ARPUS
(AGC Refrigerant properties software)